Produkte
Products

Prüfbericht-Nr.: *Test Report No.*:	**50114385 001**	**Auftrags-Nr.:** *Order No.*:	**144165052**	**Seite 1 von 19** *Page 1 of 19*
Kunden-Referenz-Nr.: *Client Reference No.*:	**N/A**	**Auftragsdatum:** *Order date*:	**27.10.2017**	
Auftraggeber: *Client*:	**Wise Ally Holdings Limited** **5/F., Chai Wan Industrial Centre, 20 Lee Chung Street, Chai Wan, Hong Kong**			
Prüfgegenstand: *Test item*:	**Short Range Device – ZigBee Green Power Device remote switch (2.4GHz)**			
Bezeichnung / Typ-Nr.: *Identification / Type No.*:	**SWS200 / 9290007669**			
Auftrags-Inhalt: *Order content*:	**FCC Certification**			
Prüfgrundlage: *Test specification*:	**FCC Part 15 Subpart C** **ANSI C63.10-2013**			
Wareneingangsdatum: *Date of receipt*:	**29.11.2017**			
Prüfmuster-Nr.: *Test sample No.*:	**A000658988-001**			
Prüfzeitraum: *Testing period*:	**27.04.2018 - 15.05.2018**			
Ort der Prüfung: *Place of testing*:	**Hong Kong**			
Prüflaboratorium: *Testing laboratory*:	**TÜV Rheinland Hong Kong Ltd.**			
Prüfergebnis*: *Test result**:	**Pass**			

geprüft von / *tested by*:			**kontrolliert von /** *reviewed by*:		
05.06.2018	Joey Leung / Project Manager		05.06.2018	Sharon Li / Unit Senior Manager	
Datum *Date*	**Name / Stellung** *Name / Position*	**Unterschrift** *Signature*	**Datum** *Date*	**Name / Stellung** *Name / Position*	**Unterschrift** *Signature*

Sonstiges / *Other*: **FCC ID: 2AGEG-DELZB0001**

Zustand des Prüfgegenstandes bei Anlieferung:
Condition of the test item at delivery:
Prüfmuster vollständig und unbeschädigt
Test item complete and undamaged

* Legende:	1 = sehr gut P(ass) = entspricht o.g. Prüfgrundlage(n)	2 = gut	3 = befriedigend F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	4 = ausreichend N/A = nicht anwendbar	5 = mangelhaft N/T = nicht getestet
Legend:	*1 = very good* *P(ass) = passed a.m. test specification(s)*	*2 = good*	*3 = satisfactory* *F(ail) = failed a.m. test specification(s)*	*4 = sufficient* *N/A = not applicable*	*5 = poor* *N/T = not tested*

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Product information

Manufacturers declarations

	Transceiver
Operating frequency range	2405 - 2480 MHz
Type of modulation	Offset quadrature phase-shift keying (OQPSK)
Number of channels	16
Channel separation	5 MHz
Type of antenna	Dual PCB Antenna
Antenna gain (dBi)	3 dBi
Power level	fix
Type of equipment	stand alone radio device
Connection to public utility power line	No
Nominal voltage	V_{nor}: 3.0 VDC
Independent Operation Modes	Transmitting

Product function and intended use

The equipment under test (EUT) is a ZigBee Green Power Device. It is intended to be permanently mounted on a wall or installed to an outlet box by a qualified technician.

FCC ID: 2AGEG-DELZB0001

Models	Product description
SWS200 / 9290007669	Short Range Device – ZigBee Green Power Device remote switch (2.4GHz)

Submitted documents

Circuit Diagram
Block Diagram
Technical Description
User manual
Label

Independent Operation Modes

The basic operation modes are:

- Transmitting mode.

For further information refer to User Manual

Note: RF signals transmit on either one of the antennae in every transmission.

Related Submittal(s) Grants

This is a single application for certification of the transmitter.

Remark

The test results in this test report are only relevant to the tested sample and does not involve any assessment in the production.

Test Set-up and Operation Mode

Principle of Configuration Selection

Emission: The equipment under test (EUT) was configured to measure its highest possible radiation level. The test modes were adapted accordingly in reference to the instructions for use.

Test Operation and Test Software

Test operation should refer to test methodology.

- During test, Channel & Power Controlling Software provided by the customer was used to control the operating channel as well as the output power level. The RF output power was selected according to the instruction given by the manufacturer. The setting of the RF output power expected by the customer shall be fixed on the firmware of the final end product.

Special Accessories and Auxiliary Equipment

- none

Countermeasures to achieve EMC Compliance

- none

Test Methodology

Radiated Emission

The radiated emission measurements of the transmitter part were performed according to the procedures in ANSI C63.10-2013.

For measurement below 1GHz - the equipment under test (EUT) was placed at the middle of the 80 cm height turntable. For measurement above 1GHz - the EUT was placed at the middle of the 1.5 m height turntable and RF absorbing material was placed on ground plane between turntable and measuring antenna. During the testing, the EUT was operated standalone and arranged for maximum emissions. The EUT was tested in three orthogonal planes.

The investigation is performed with the EUT rotated 360 ° , the antenna height scanned between 1m and 4m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. Repeat the measurement steps until the maximum emissions were obtained.

All radiated tests were performed at an antenna to EUT with 3 meters distance, unless stated otherwise in particular parts of this test report.

Field Strength Calculation

The field strength at 3 m was established by adding the meter reading of the spectrum analyzer to the factors associated with antenna correction factor, cable loss, preamplifiers and filter attenuation.

The equation is expressed as follow:

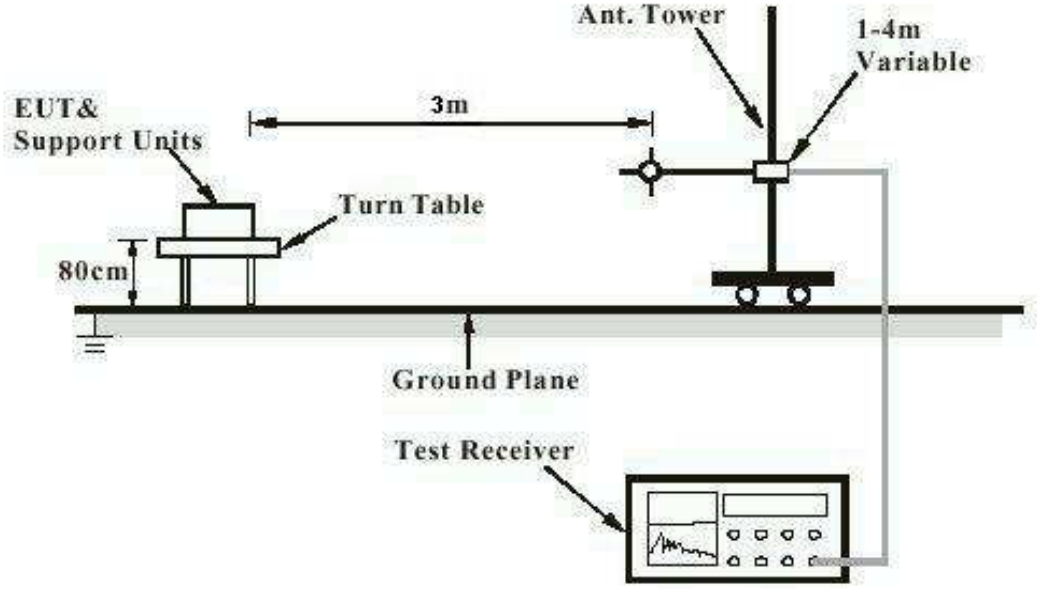
FS = R + AF + CF + FA – PA

Where FS = Field Strength in dBuV/m at 3 meters.
R = Reading of Spectrum Analyzer in dBuV.
AF = Antenna Factor in dB.
CF = Cable Attenuation Factor in dB.
FA = Filter Attenuation Factor in dB.
PA = Preamplifier Factor in dB.

FA and PA are only be used for the measuring frequency above 1 GHz.

Test Setup Diagram

Diagram of Measurement Configuration for Radiation Test



Note: Measurements above 1 GHz are done with a table height of 1.5m. In addition, there is RF absorbing material on the floor of the test site for above 1GHz measurement.

Diagram of Measurement Equipment Configuration for Mains Conduction Measurement (if applicable)

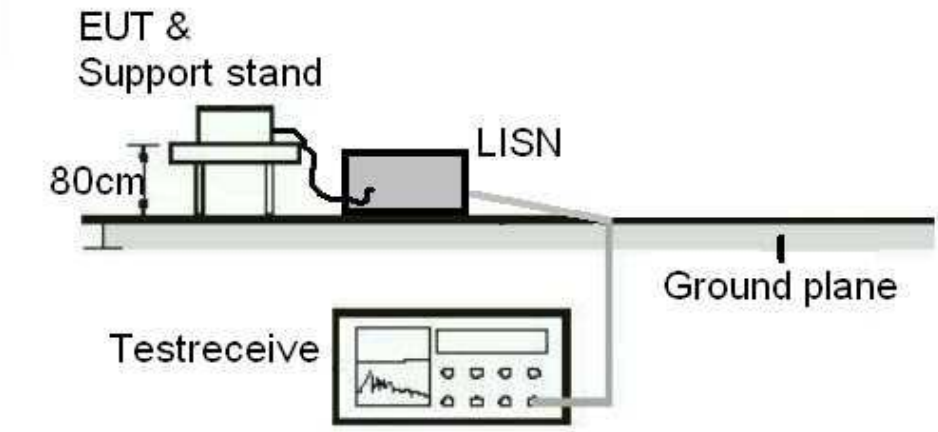
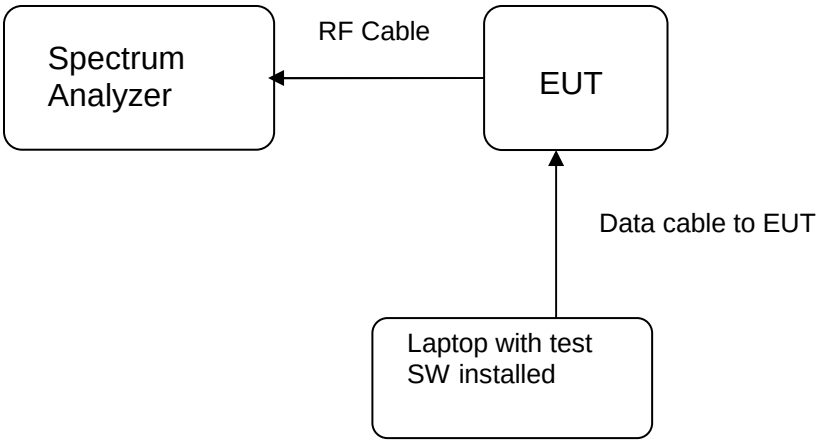


Diagram of Equipment Configuration for Antenna-port Conducted Measurement (if applicable)



Test Facility

Test Laboratory Information

TÜV Rheinland Hong Kong Ltd.
Address: 3-4, 11/F., Fou Wah Industrial Building, 10-16 Pun Shan Street, Tsuen Wan, N.T., Hong Kong·
Tel.: +852 2192 1000
Fax: +852 2192 1001
Email service-gc@tuv.com
Web: www.tuv.com

The test facility is recognized or accredited by the following organizations:

Type	:	Accredited Test Firm
Designation Number	:	HK0013
Test Firm Registration Number	:	371735
Scope	:	Intentional Radiators

List of Test and Measurement Instruments

Hong Kong Productivity Council (Registration number: 90656)

Radiated Emission

Equipment	Manufacturer	Type	Cal. Date	Due Date
Semi-anechoic Chamber	Frankonia	Nil	23 Apr 2018	23 Apr 2019
Test Receiver	R & S	ESU40	07 Sep 2017	07 Sep 2018
Active Loop Antenna	EMCO	6502	30 Oct 2017	30 Oct 2018
Bi-conical Antenna	R & S	HK116	07 Jun 2016	07 Jun 2018
Log Periodic Antenna	R & S	HL223	31 May 2016	31 May 2018
Horn Antenna	EMCO	3115	28 Mar 2018	28 Mar 2020
Double-Ridged Waveguide Horn	EMCO	3116	17 Jun 2016	17 Jun 2018
Double-Ridged Waveguide Horn	EMCO	3117	22 Jun 2016	22 Jun 2018
Coaxial cable	Harbour	LL335	10 Jun 2016	10 Jun 2018
High Frequency Cable	Pasternack	PE3VNA4001-3M	29 Jan 2018	29 Jan 2019
Microwave amplifer 0.5-26.5GHz, 25dB gain	HP	83017A	18 Jul 2016	18 Jul 2018
Preamplifier 18GHz to 40GHz with cable (EMC656)	A.H. Systems, Inc.	PAM-1840VH	29 Jan 2018	29 Jan 2019
High Pass Filter (cutoff freq. =1000MHz)	Trilithic	23042	30 Oct 2017	30 Oct 2019

Radio Test

Equipment	Manufacturer	Type	Cal. Date	Due Date
Spectrum Analyzer	R & S	FSP30	03 May 2018	02 May 2019

Measurement Uncertainty

The estimated combined standard uncertainty for power-line conducted emissions measurements is ±2.42dB.

The estimated combined standard uncertainty for radiated emissions measurements is ±4.81dB (9kHz to 30MHz) and ±4.62dB (30MHz to 200MHz) and ±5.67dB (200MHz to 1000MHz) and is ±5.07dB (1GHz to 8.2GHz) and ±4.58dB (8.2GHz to 12.4GHz) and ±4.78dB (12.4GHz to 18GHz)

The estimated combined standard uncertainty for antenna conducted emission is ±2.1dB

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor of k=2, which for the level of confidence is approximately 95%.

Results FCC Part 15 – Subpart C

FCC 15.203 – Antenna Requirement 1		Pass
FCC Requirement:	No antenna other than that furnished by the responsible party shall be used with the device	
Results:	a) Antenna type: b) Manufacturer and model no: c) Peak Gain:	Integral PCB antenna N/A 3 dBi
Verdict:	Pass	

FCC 15.204 – Antenna Requirement 2		N/A
FCC Requirement:	An intentional radiator may be operated only with the antenna with which it is authorized. If an antenna is marketed with the intentional radiator, it shall be of a type which is authorized with the intentional radiator.	
Results:	Only one integral antenna can be used.	
Verdict:	N/A	

FCC 15.207 – Conducted Emission on AC Mains	N/A
There is no AC power input or output ports on the EUT.	

FCC 15.247 (a)(2) – 6dB Bandwidth Measurement	Pass

FCC Requirement: Systems using digital modulation techniques may operate in the 902 – 928 MHz, 2400 – 2483.5 MHz, and 5725 – 5850 MHz bands. The minimum 6dB bandwidth shall be at least 500kHz.

Test Specification : ANSI C63.10 – 2013
Test date : 15.05.2018
Mode of operation : Tx mode
Port of testing : Temporary antenna port
Supply voltage : 3.0VDC
Temperature : 23ºC
Humidity : 50%

Results: For test protocols please refer to Appendix 1

ANT0

Channel frequency (MHz)	6 dB left (MHz)	6 dB right (MHz)	6dB bandwidth (kHz)
2405	2404.202	2405.812	1610
2440	2439.196	2440.806	1610
2480	2479.216	2480.812	1596

ANT1

Channel frequency (MHz)	6 dB left (MHz)	6 dB right (MHz)	6dB bandwidth (kHz)
2405	2404.202	2405.826	1624
2440	2439.202	2440.812	1610
2480	2479.214	2480.804	1590

FCC 15.247(b)(3) – Maximum Peak Conducted Output Power	Pass

FCC Requirement: For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850MHz bands: 1 Watt (30dBm)

Test Specification : ANSI C63.10 – 2013
Test date : 15.05.2018
Mode of operation : Tx mode
Port of testing : Temporary antenna port
Supply voltage : 3.0VDC
Temperature : 23ºC
Humidity : 50%

Results: For test protocols please refer to Appendix 1

ANT0

Frequency (MHz)	Measured Output Power (dBm)	Limit (W/dBm)	Verdict
2405	3.04	1 / 30.0	Pass
2440	2.82	1 / 30.0	Pass
2480	2.49	1 / 30.0	Pass

ANT1			
Frequency (MHz)	**Measured Output Power (dBm)**	**Limit (W/dBm)**	**Verdict**
2405	0.90	1 / 30.0	Pass
2440	0.96	1 / 30.0	Pass
2480	0.66	1 / 30.0	Pass

FCC 15.247(e) – Power Spectral Density **Pass**

FCC Requirement: For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

Test Specification : ANSI C63.10 – 2013
Test date : 15.05.2018
Mode of operation : Tx mode
Port of testing : Temporary antenna port
Supply voltage : 3.0VDC
Temperature : 23ºC
Humidity : 50%

Results: For test protocols please refer to Appendix 1.

ANT0

Operating frequency (MHz)	**Power density (dBm)**	**Limit (dBm)**	**Verdict**
2405	-0.29	8.0	Pass
2440	-0.46	8.0	Pass
2480	-0.86	8.0	Pass

ANT1

Operating frequency (MHz)	**Power density (dBm)**	**Limit (dBm)**	**Verdict**
2405	-2.33	8.0	Pass
2440	-2.39	8.0	Pass
2480	-2.53	8.0	Pass

FCC 15.247(d) – Spurious Conducted Emissions **Pass**

Test Specification : ANSI C63.10 – 2013
Test date : 17.05.2018
Mode of operation : Tx mode
Port of testing : Temporary antenna port
Supply voltage : 3.0VDC
Temperature : 23ºC
Humidity : 50%

FCC Requirement: In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

Results: Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and data rate.

Only the worst cases is shown below. For test protocols refer to Appendix 1

ANT0

Operating frequency (MHz)	Spurious frequency (MHz)	Spurious Level (dBm)	Reference value (dBm)	Delta (dB)	Verdict
2405	24592.000	-30.91	-0.29	-30.62	Pass
2440	24640.000	-30.84	-0.46	-30.38	Pass
2480	24592.000	-29.97	-0.86	-29.11	Pass

ANT1

Operating frequency (MHz)	Spurious frequency (MHz)	Spurious Level (dBm)	Reference value (dBm)	Delta (dB)	Verdict
2405	24568.000	-30.47	-2.33	-28.14	Pass
2440	24256.000	-31.53	-2.39	-29.14	Pass
2480	23104.000	-30.89	-2.53	-28.36	Pass

FCC 15.205 – Radiated Emissions in Restricted Frequency Bands	**Pass**

Test Specification : ANSI C63.10 – 2013
Test Date : 01.05.2018
Mode of operation : Tx mode
Port of testing : Enclosure
Frequency range : 9kHz – 25GHz
Supply voltage : 4.5VDC
Temperature : 23ºC
Humidity : 50%

FCC Requirement: In any 100kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in section15.205(a), must also comply with the radiated emission limits specified in section 15.205(c).

Results: Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and data rate.

All three transmit frequency modes comply with the field strength within the restricted bands. There is no spurious found below 30MHz.

ANT0

Mode: 2405 MHz TX — Vertical Polarization

Freq MHz	**Level dBuV/m**	**Limit/ Detector dBuV/m**
2317.564	48.55	74.0 / PK
2390.000	34.39	54.0 / AV
4809.022	61.30	74.0 / PK
4810.977	49.78	54.0 / AV

Mode: 2405 MHz TX — Horizontal Polarization

Freq MHz	**Level dBuV/m**	**Limit/ Detector dBuV/m**
2363.846	48.10	74.0 / PK
2360.897	34.26	54.0 / AV
4810.929	60.97	74.0 / PK
4809.150	49.66	54.0 / AV

Mode: 2440 MHz TX — Vertical Polarization

Freq MHz	**Level dBuV/m**	**Limit/ Detector dBuV/m**
4880.971	59.09	74.0 / PK
4880.939	47.03	54.0 / AV

Mode: 2440 MHz TX — Horizontal Polarization

Freq MHz	**Level dBuV/m**	**Limit/ Detector dBuV/m**
4879.054	60.12	74.0 / PK
4880.897	48.63	54.0 / AV

Mode: 2480MHz TX	Vertical Polarization	
Freq MHz	**Level dBuV/m**	**Limit/ Detector dBuV/m**
2483.526	69.70	74.0 / PK
2483.500	37.65	54.0 / AV
4961.009	58.38	74.0 / PK
4959.070	46.37	54.0 / AV
Mode: 2480 MHz TX	Horizontal Polarization	
Freq MHz	**Level dBuV/m**	**Limit/ Detector dBuV/m**
2483.526	62.28	74.0 / PK
2483.526	36.63	54.0 / AV
4959.102	62.28	74.0 / PK
4959.054	46.62	54.0 / AV

ANT1		
Mode: 2405 MHz TX	Vertical Polarization	
Freq MHz	**Level dBuV/m**	**Limit/ Detector dBuV/m**
2361.025	48.38	74.0 / PK
2390.000	34.84	54.0 / AV
4811.025	62.98	74.0 / PK
4810.096	52.44	54.0 / AV
Mode: 2405 MHz TX	Horizontal Polarization	
Freq MHz	**Level dBuV/m**	**Limit/ Detector dBuV/m**
2323.974	48.08	74.0 / PK
2390.000	34.24	54.0 / AV
4811.250	58.89	74.0 / PK
4810.849	47.66	54.0 / AV
Mode: 2440 MHz TX	Vertical Polarization	
Freq MHz	**Level dBuV/m**	**Limit/ Detector dBuV/m**
4881.169	61.73	74.0 / PK
4880.048	50.64	54.0 / AV
Mode: 2440 MHz TX	Horizontal Polarization	
Freq MHz	**Level dBuV/m**	**Limit/ Detector dBuV/m**
4878.878	58.90	74.0 / PK
4879.102	47.68	54.0 / AV
Mode: 2480MHz TX	Vertical Polarization	
Freq MHz	**Level dBuV/m**	**Limit/ Detector dBuV/m**
2483.500	67.36	74.0 / PK
2483.526	37.16	54.0 / AV
4958.942	61.78	74.0 / PK
4959.102	50.78	54.0 / AV

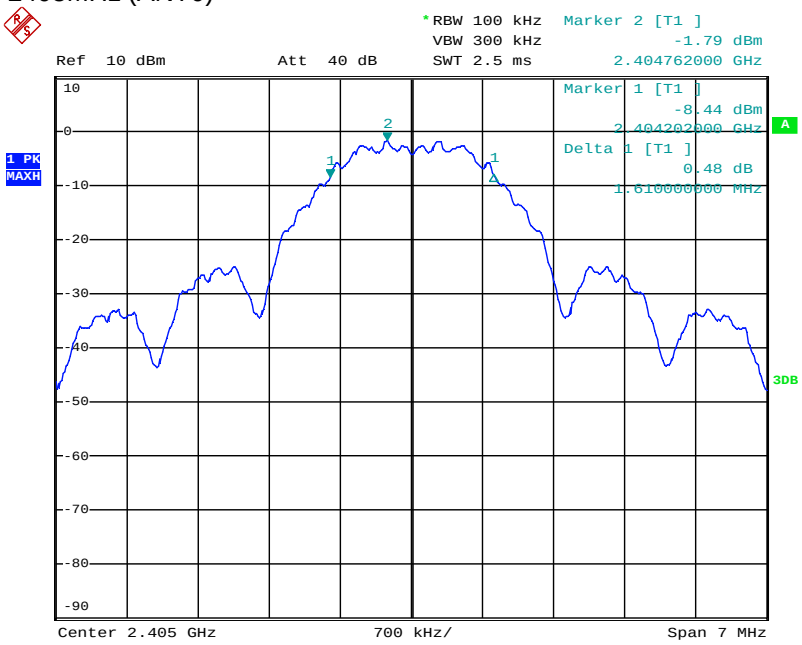
Mode: 2480 MHz TX	Horizontal Polarization	
Freq MHz	**Level dBuV/m**	**Limit/ Detector dBuV/m**
2483.528	63.09	74.0 / PK
2483.526	36.62	54.0 / AV
4959.086	58.96	74.0 / PK
4959.102	47.26	54.0 / AV

Appendix 1

Test Results

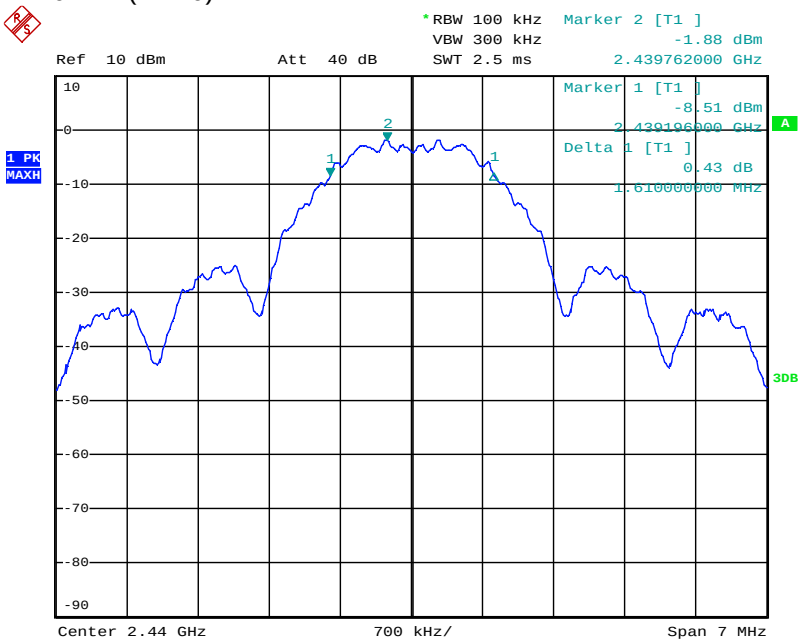
6 dB Bandwidth Measurement

TX frequency: 2405MHz (ANT0)



Date: 14.MAY.2018 18:00:14

TX frequency: 2440MHz (ANT0)



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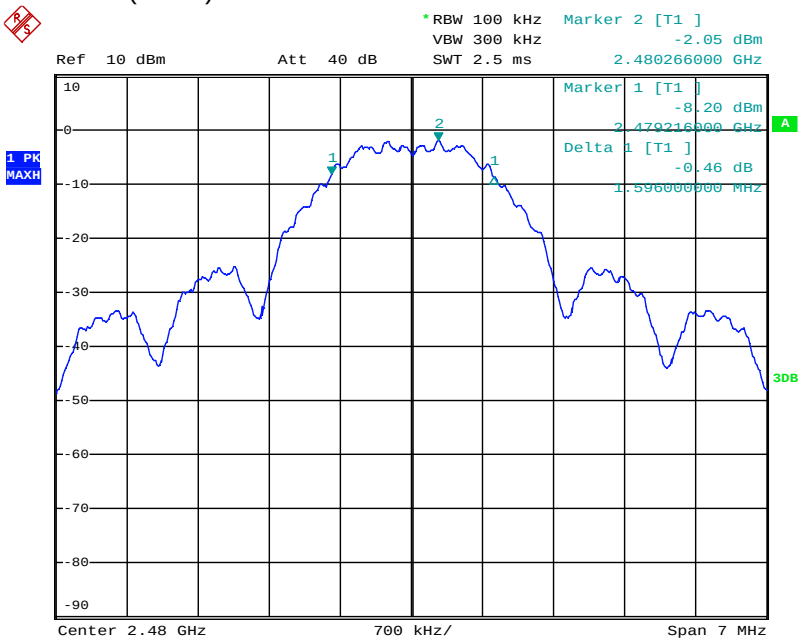
TX frequency: 2480MHz (ANT0)



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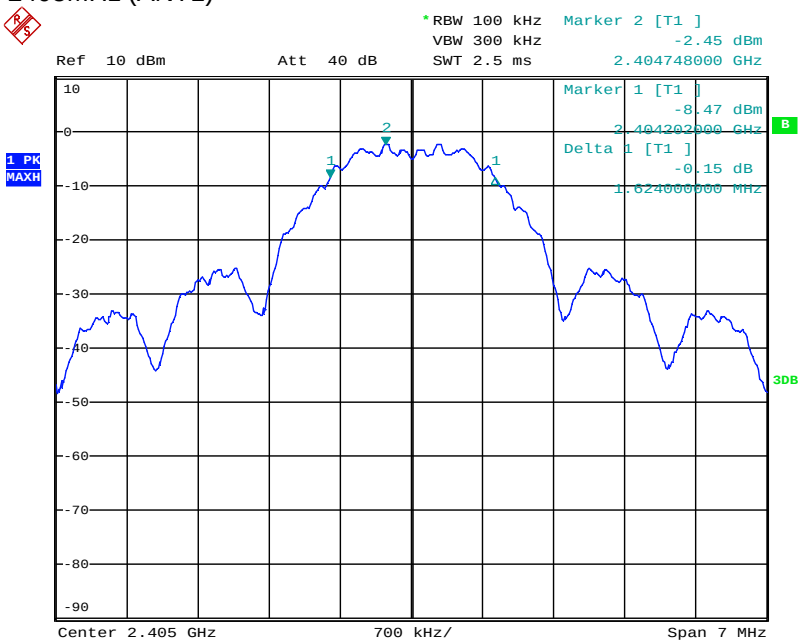
TX frequency: 2405MHz (ANT1)



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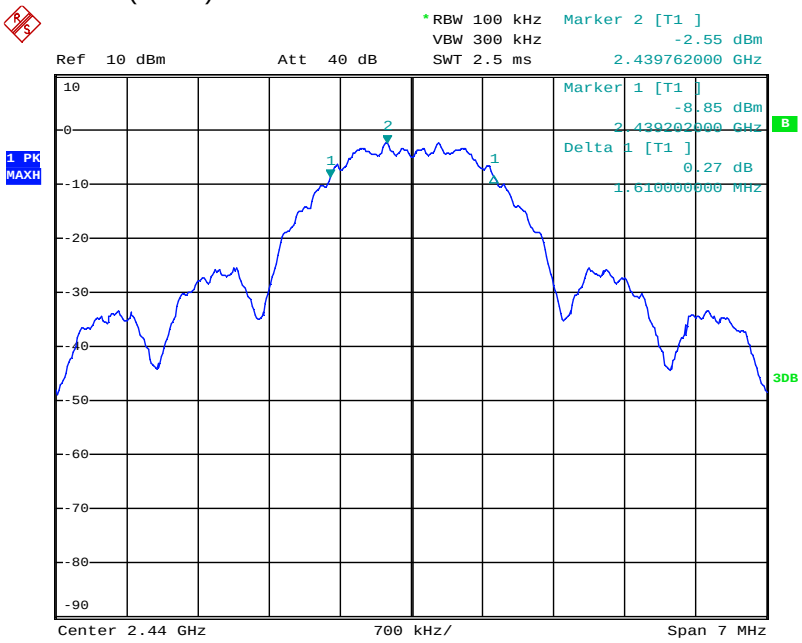
TX frequency: 2440MHz (ANT1)



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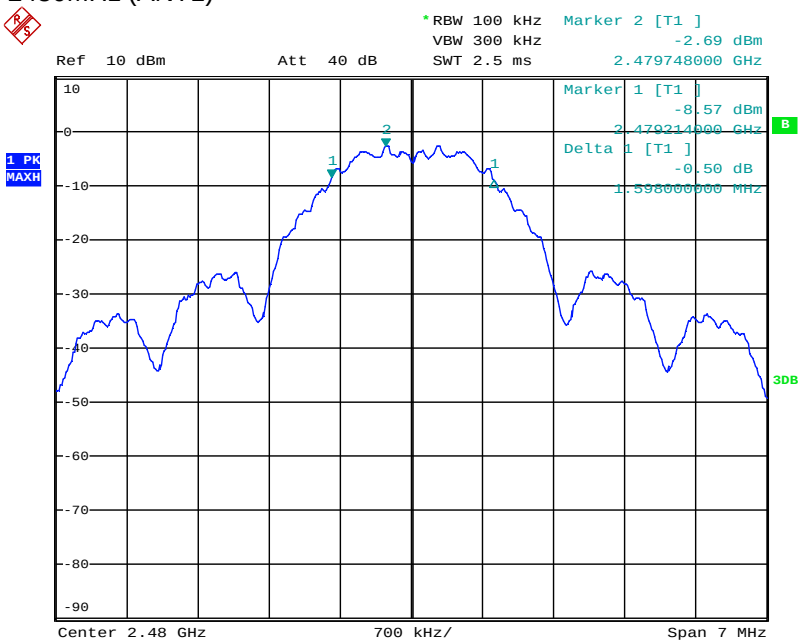
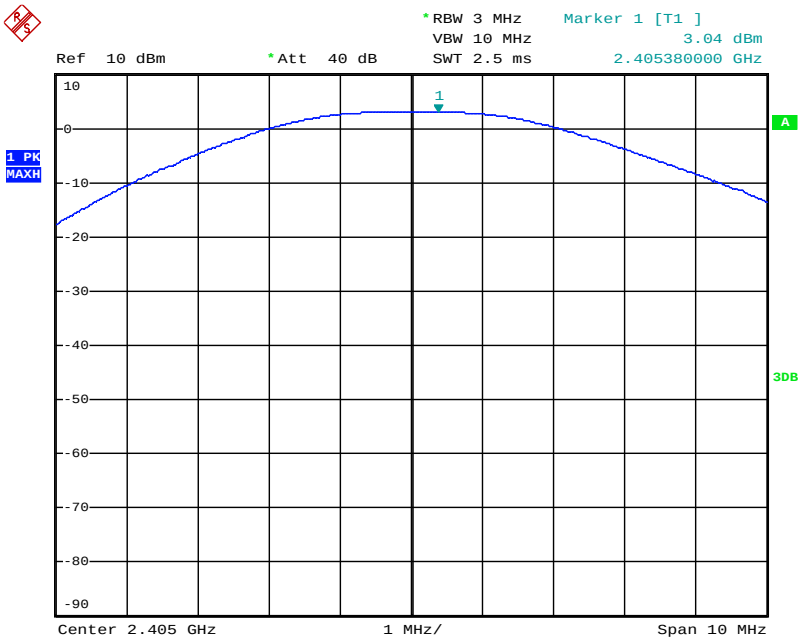
TX frequency: 2480MHz (ANT1)



Date: 15.MAY.2018 14:09:52

Maximum Conducted Output Power

TX frequency: 2405MHz (ANT0)



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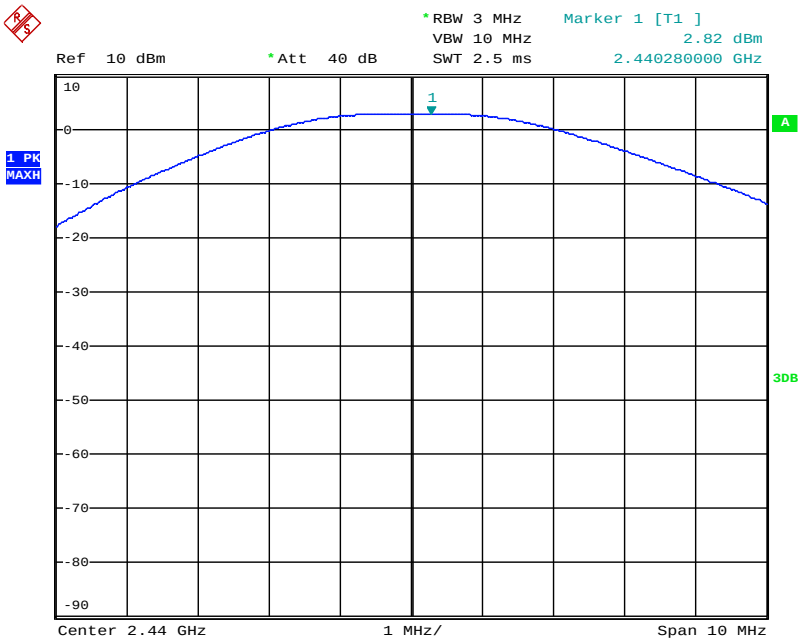
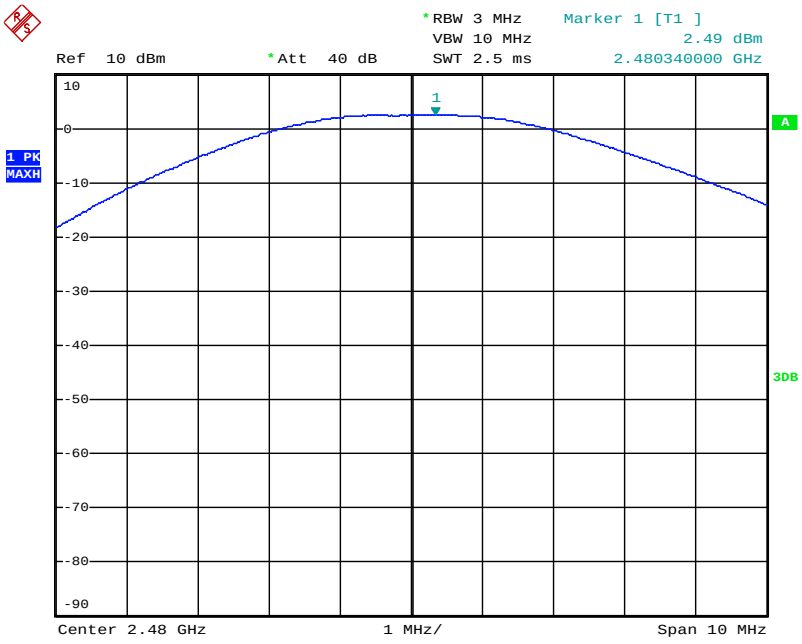
TX frequency: 2440MHz (ANT0)



Date: 15.MAY.2018 13:11:41

TX frequency: 2480MHz (ANT0)



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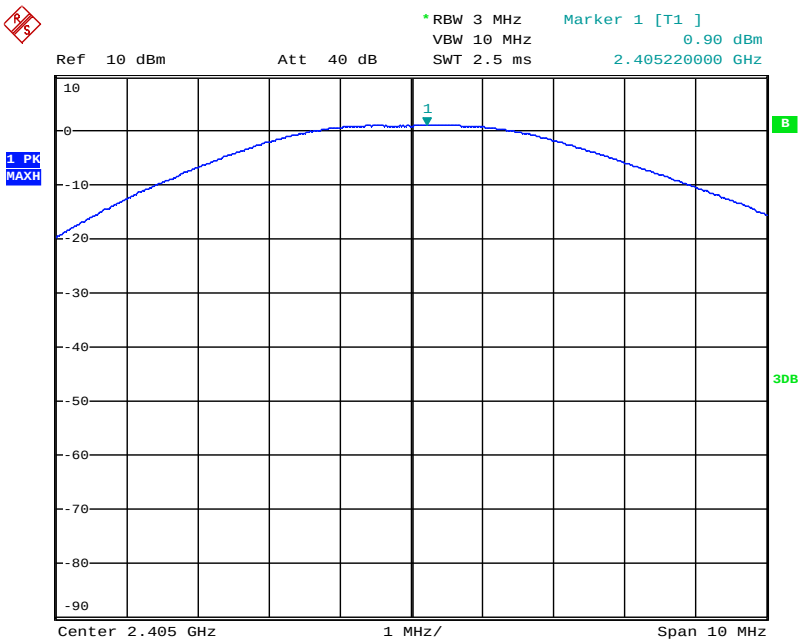
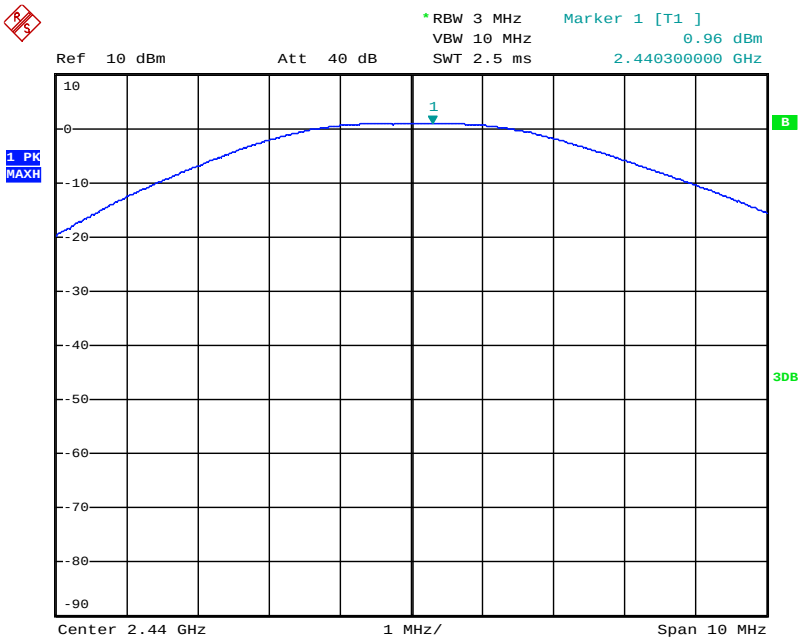


Date: 15.MAY.2018 14:16:52

TX frequency: 2440MHz (ANT1)



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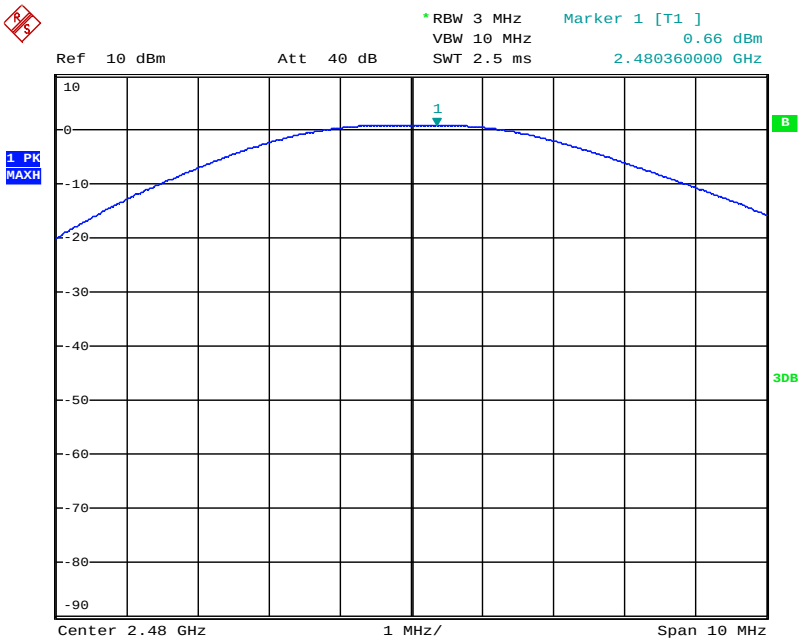
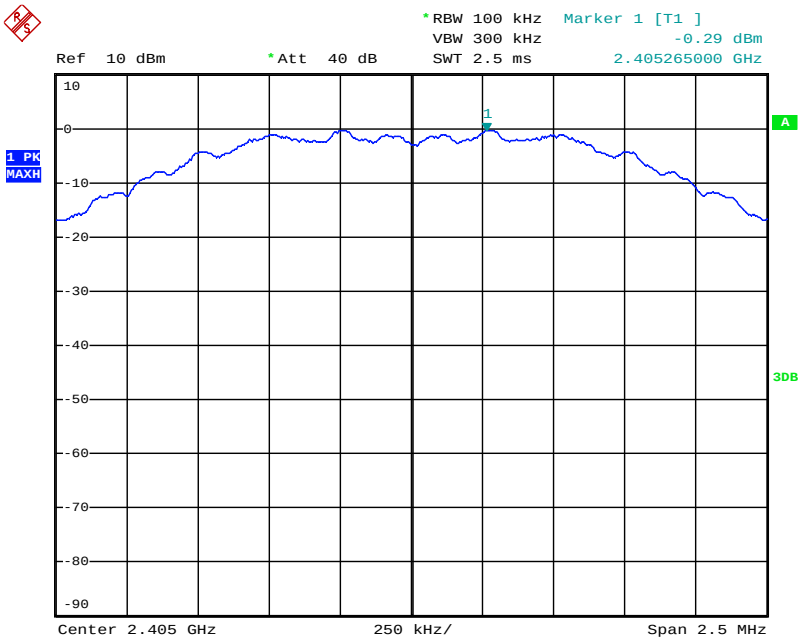


Date: 15.MAY.2018 14:41:00

Power Spectral Density

TX frequency: 2405MHz (ANT0)



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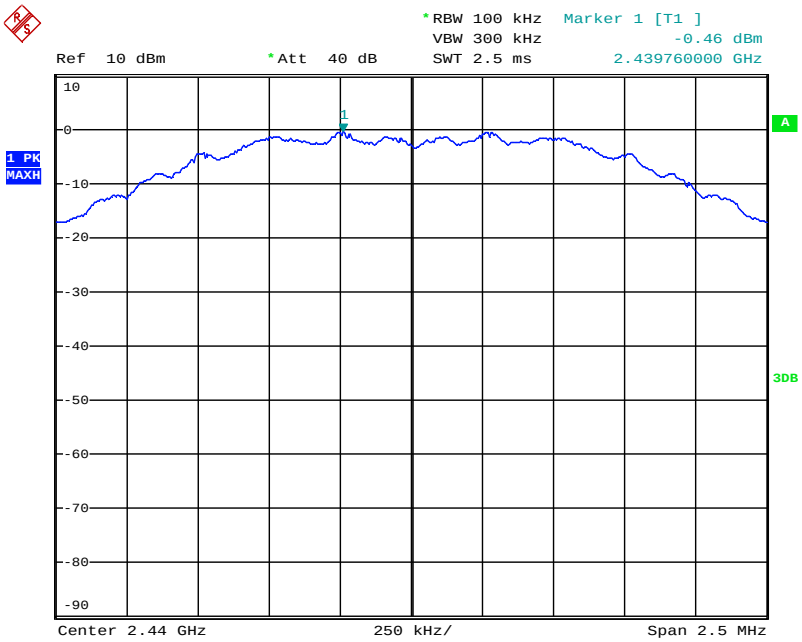
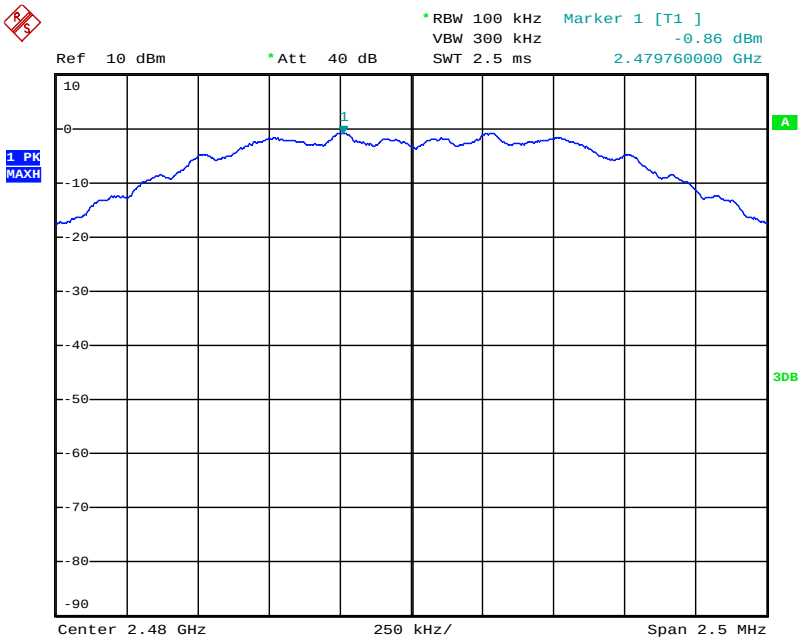
TX frequency: 2440MHz (ANT0)



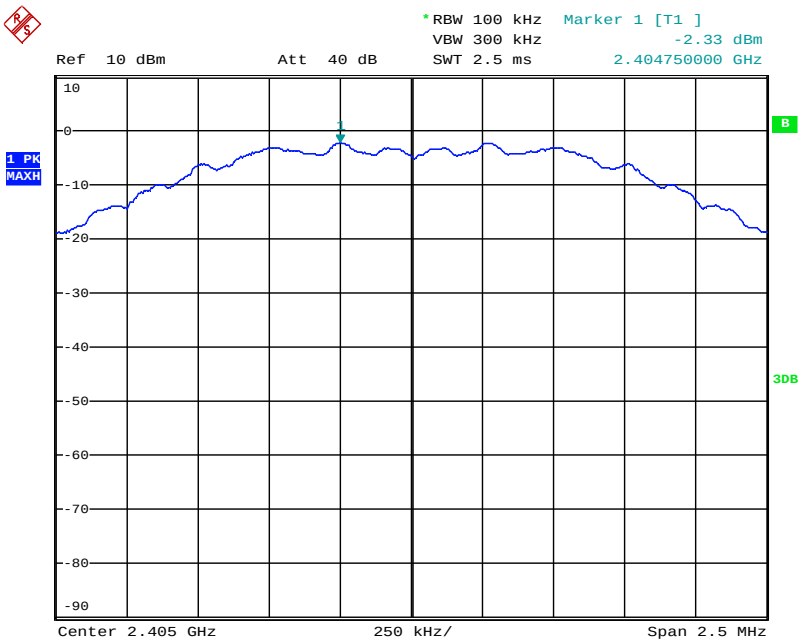
Date: 15.MAY.2018 13:16:35

TX frequency: 2480MHz (ANT0)



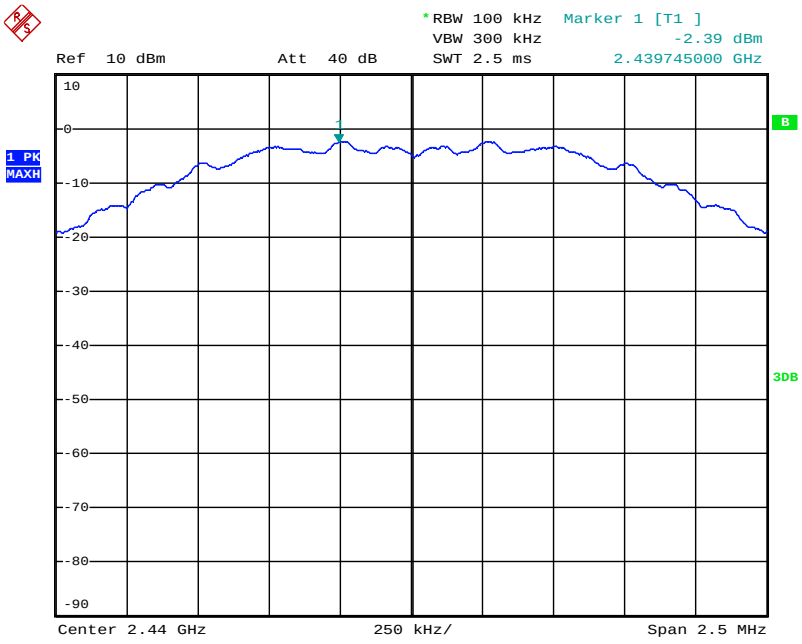
Date: 15.MAY.2018 13:17:45

TX frequency: 2405MHz (ANT1)



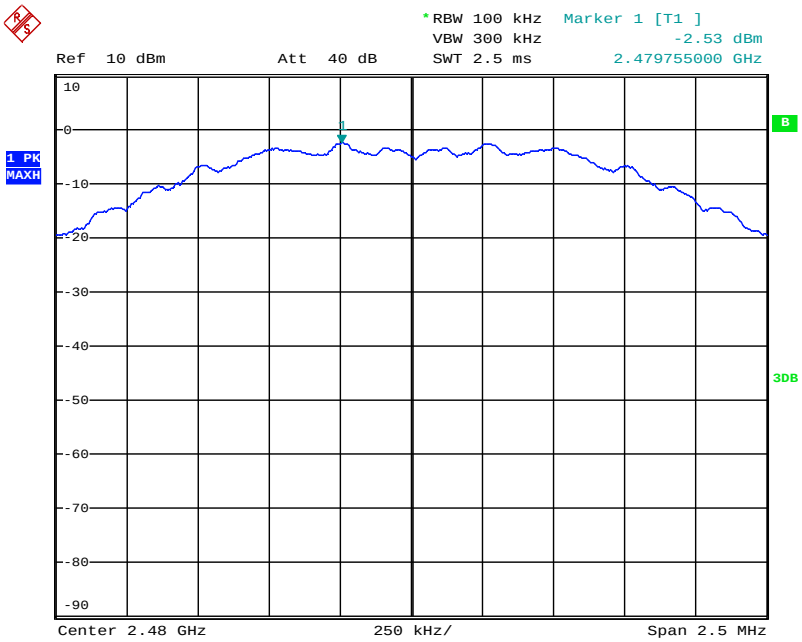
Date: 15.MAY.2018 14:46:30

TX frequency: 2440MHz (ANT1)



Date: 15.MAY.2018 14:45:10

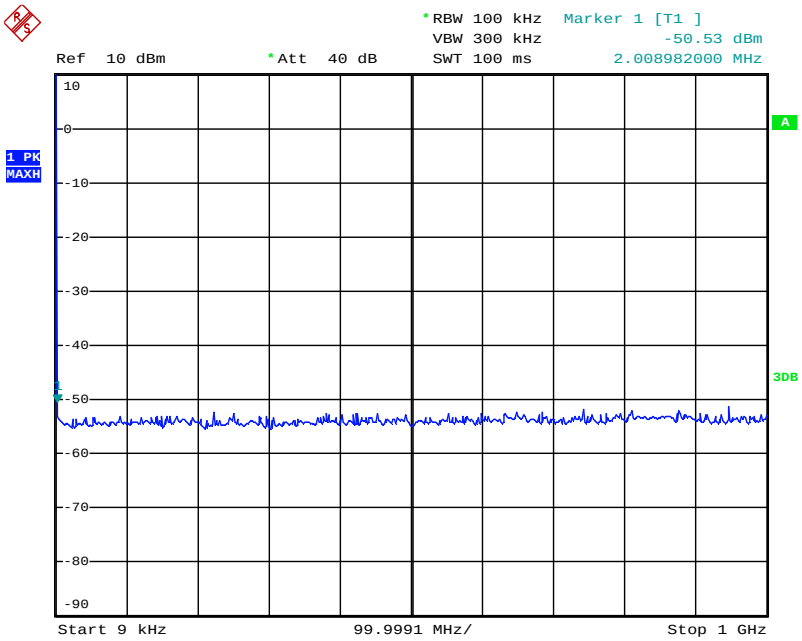
TX frequency: 2480MHz (ANT1)



Date: 15.MAY.2018 14:42:20

Spurious Conducted Emissions

TX frequency: 2405MHz (ANT0)



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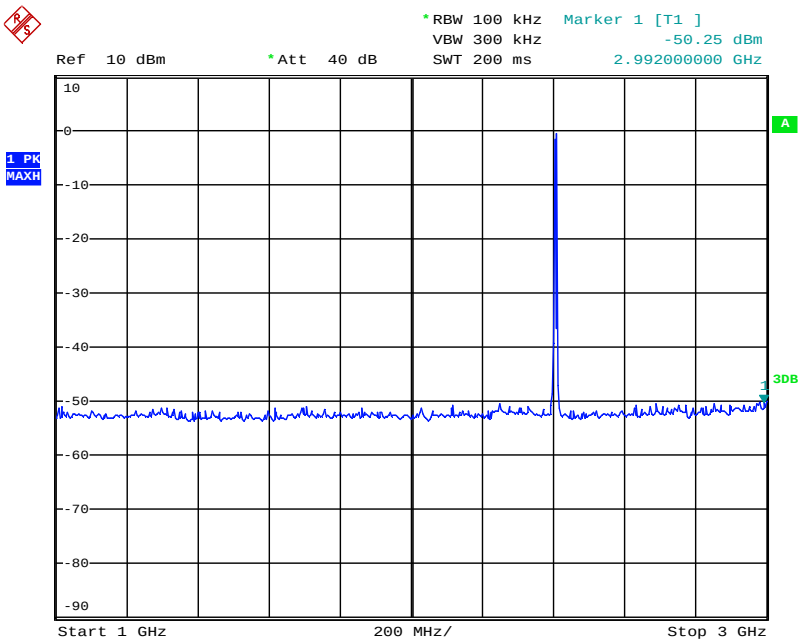

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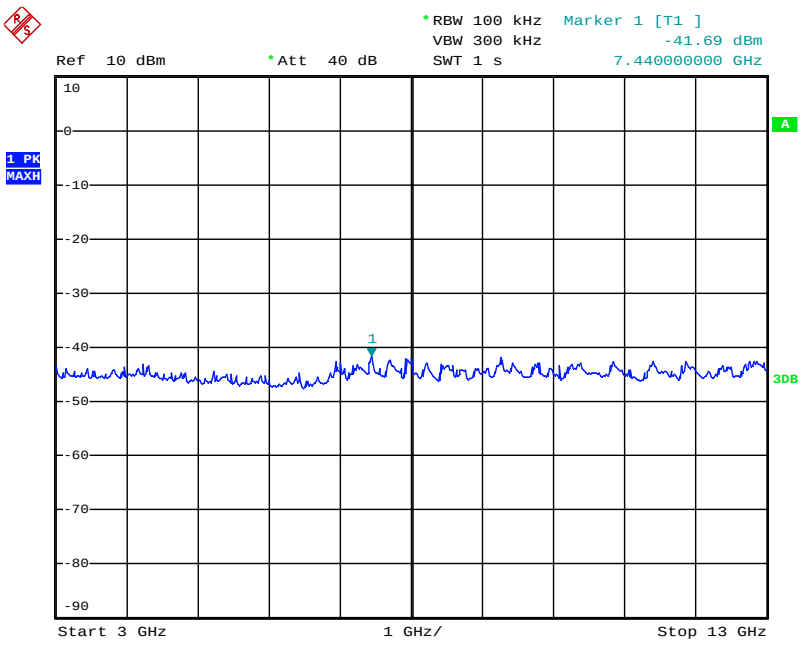

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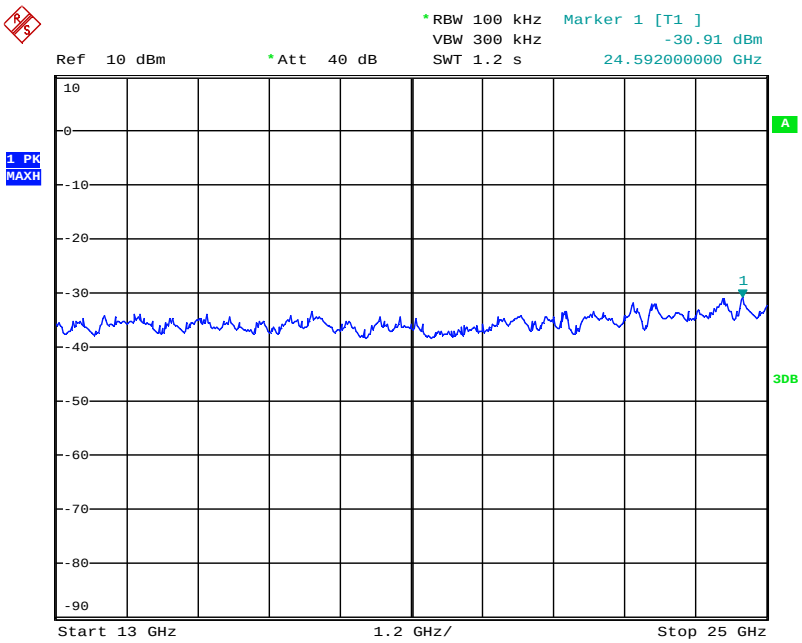

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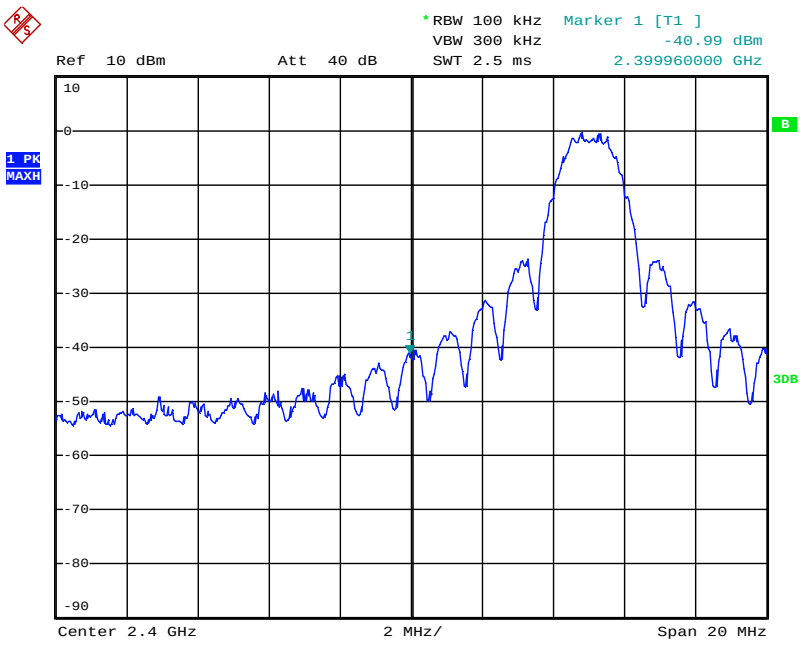
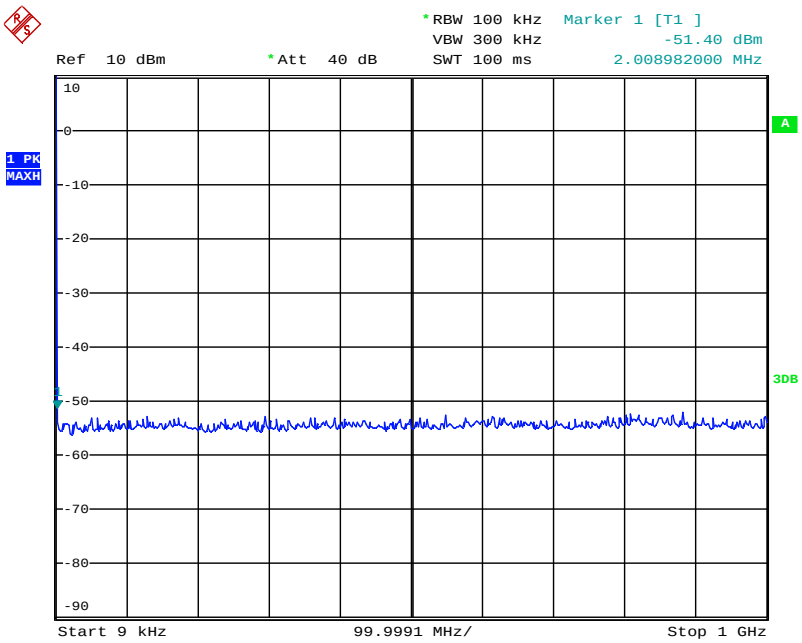


Date: 15.MAY.2018 13:43:20

TX frequency: 2440MHz (ANT0)



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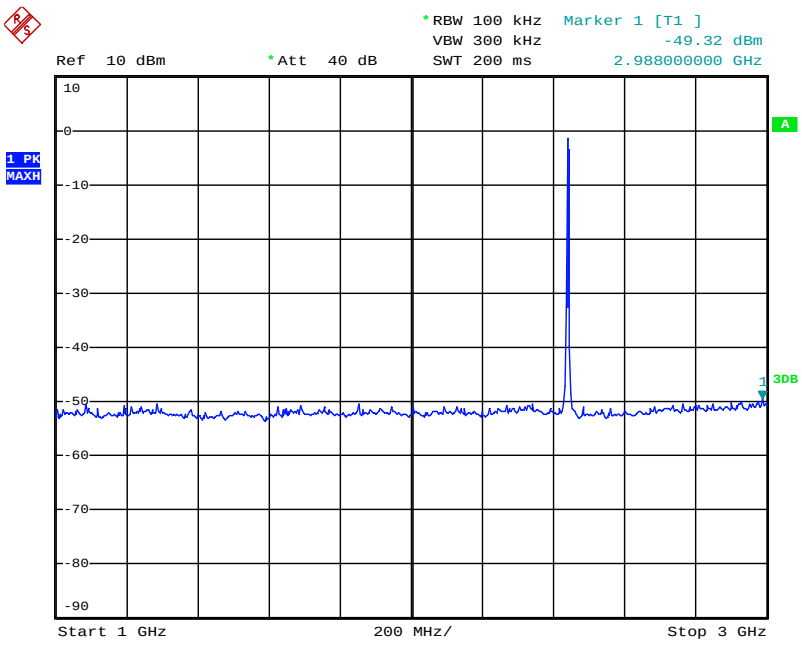

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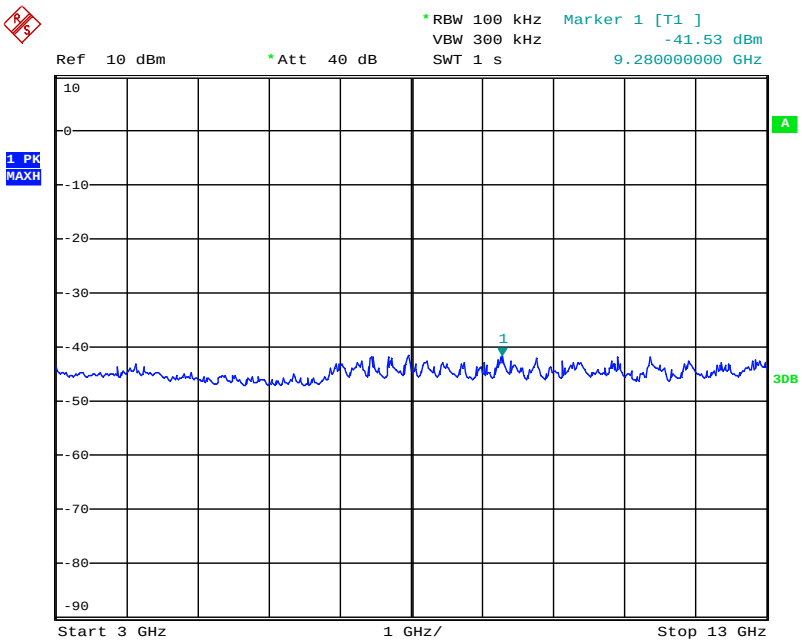

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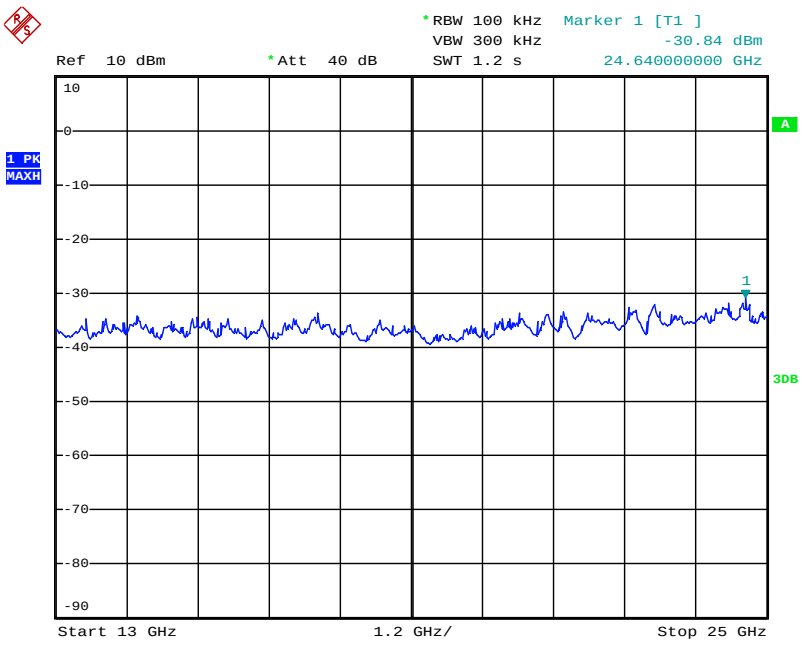

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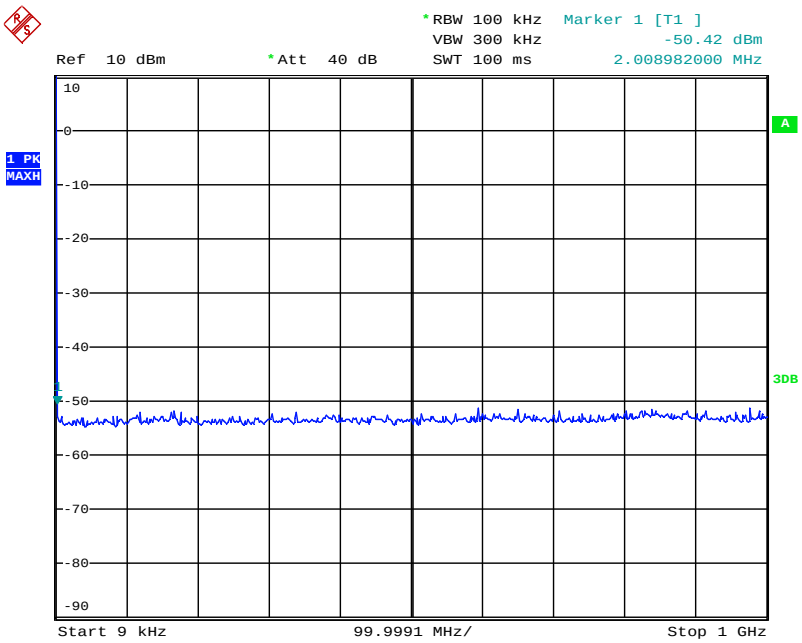
TX frequency: 2480MHz (ANT0)



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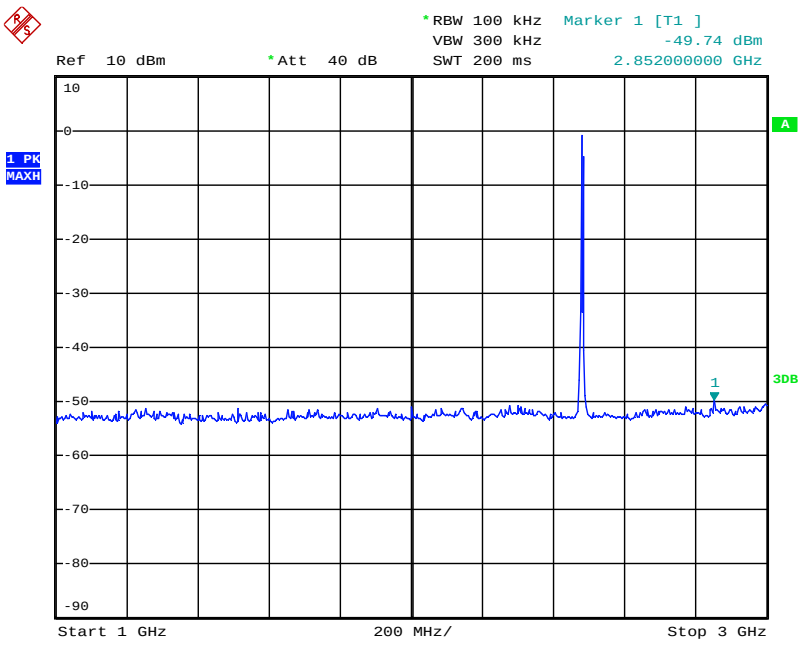

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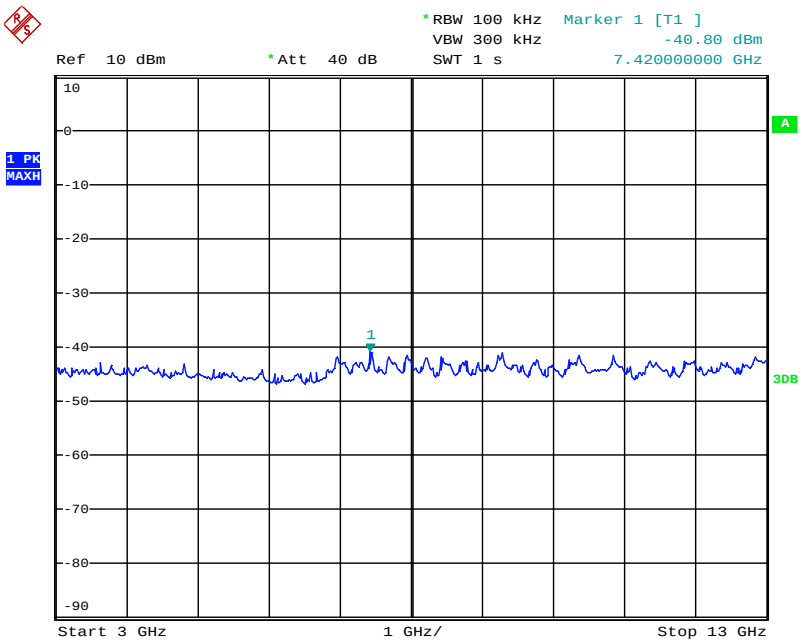

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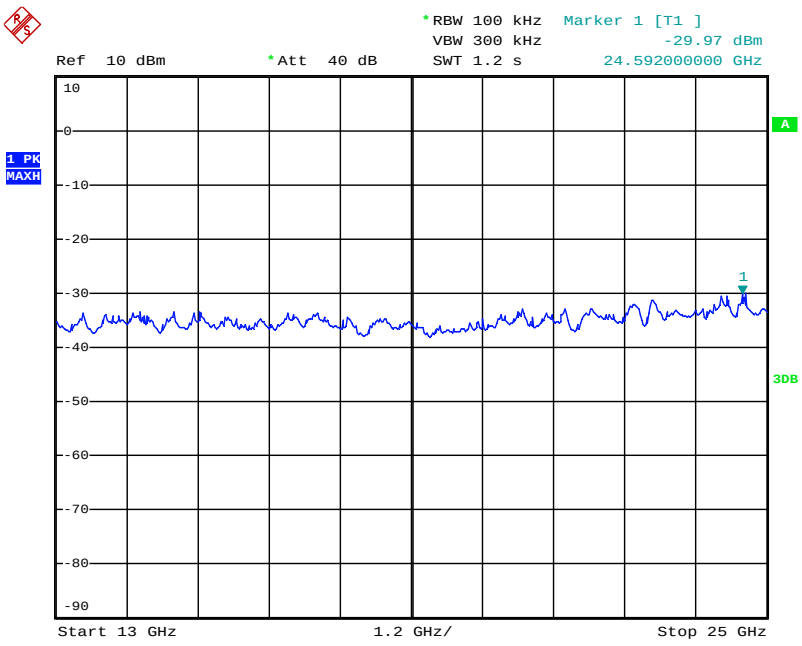

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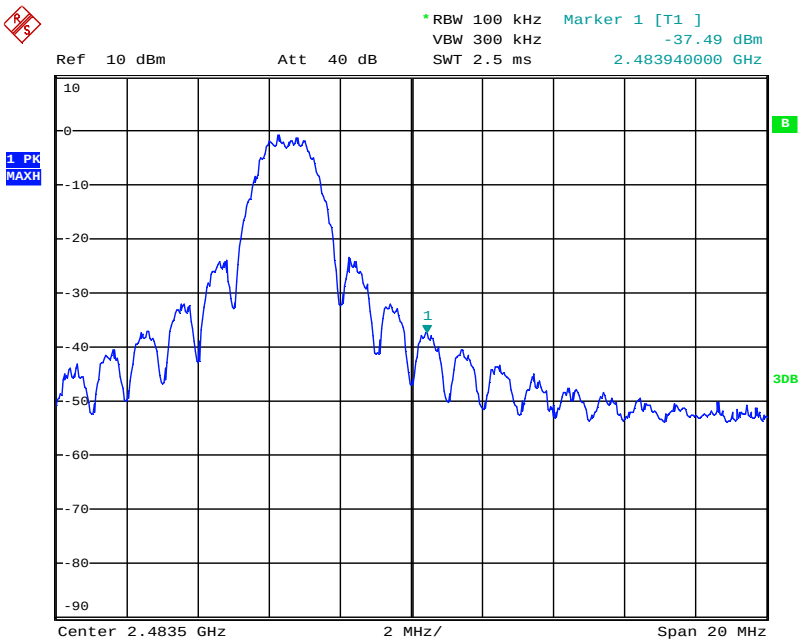

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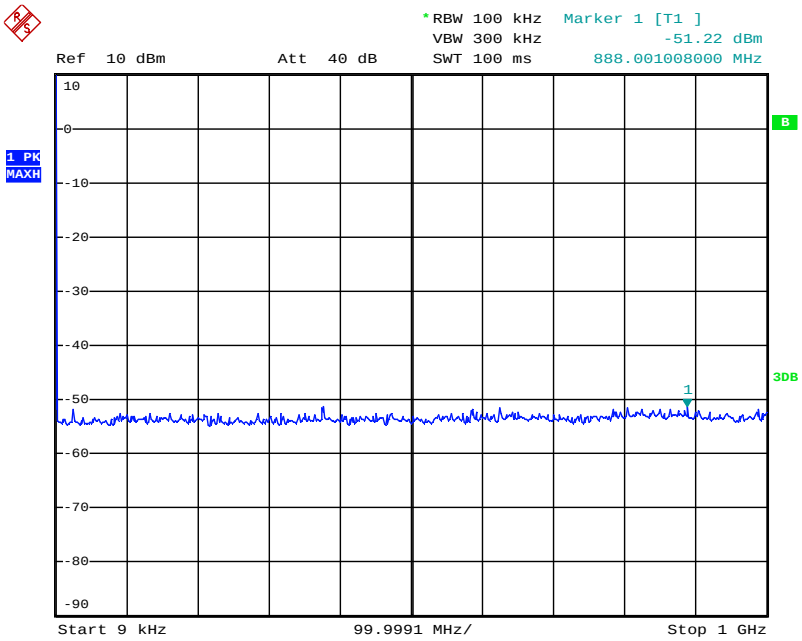
TX frequency: 2405MHz (ANT1)



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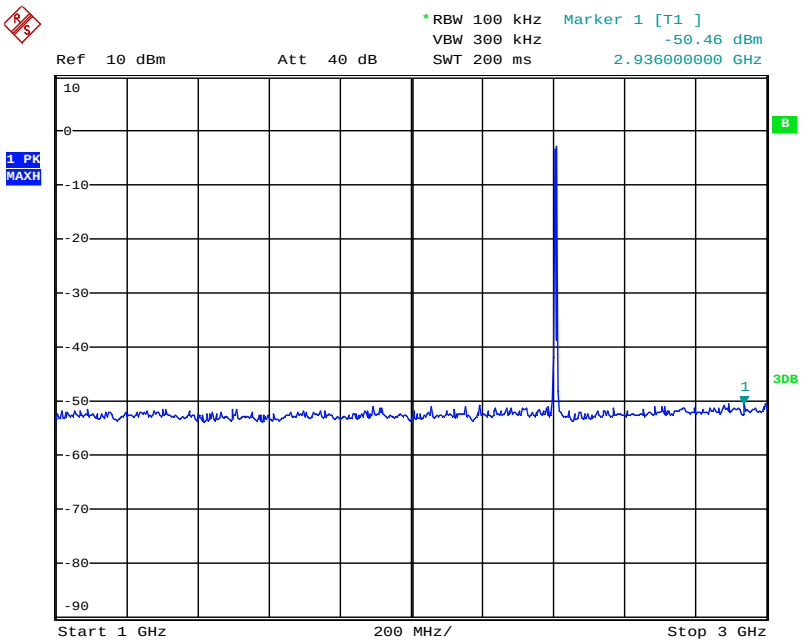

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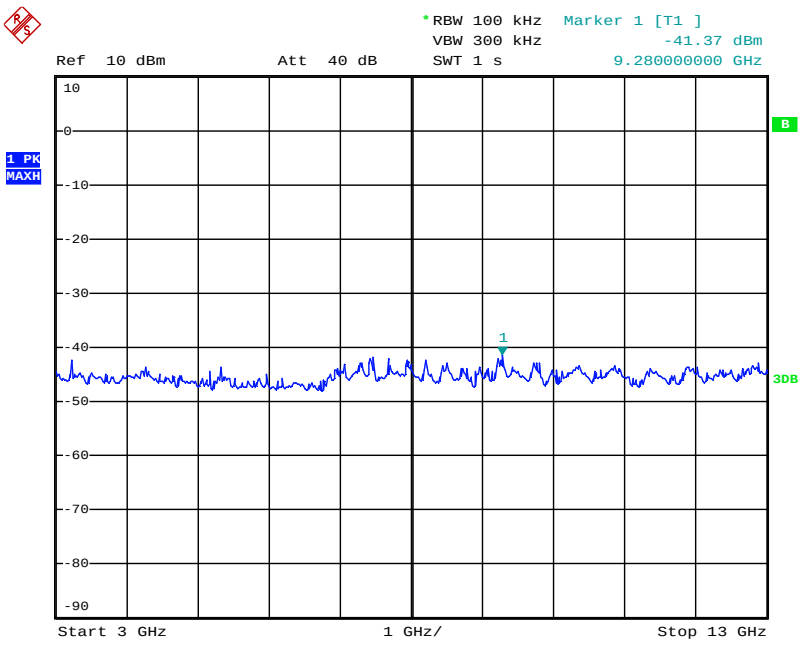

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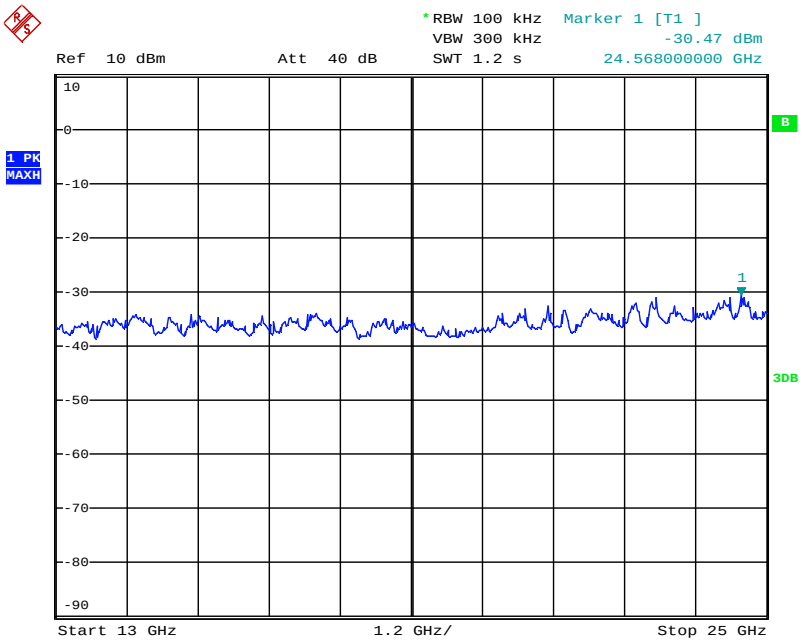

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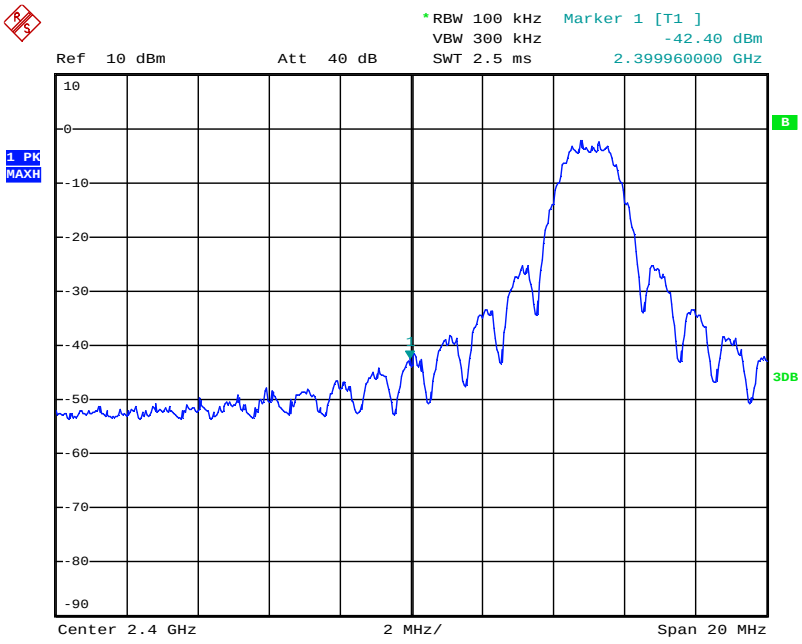

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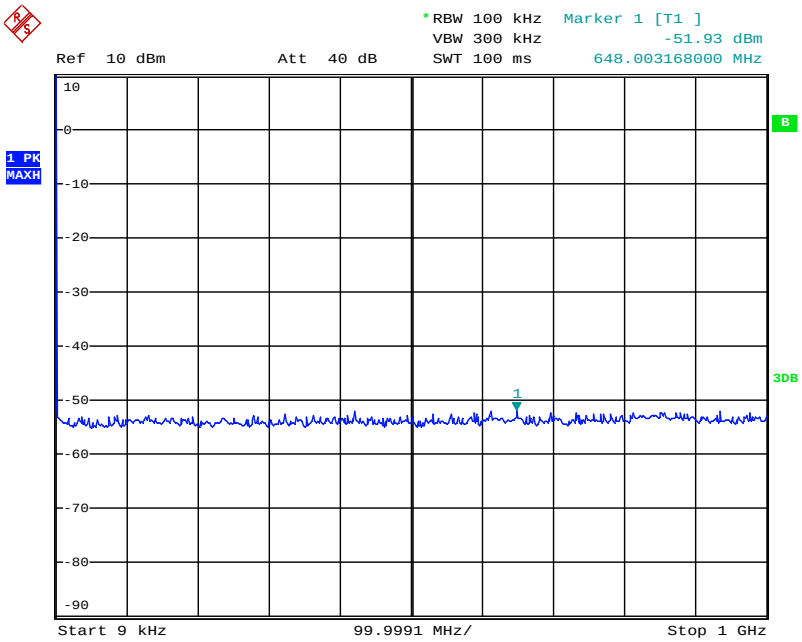
TX frequency: 2440MHz (ANT1)



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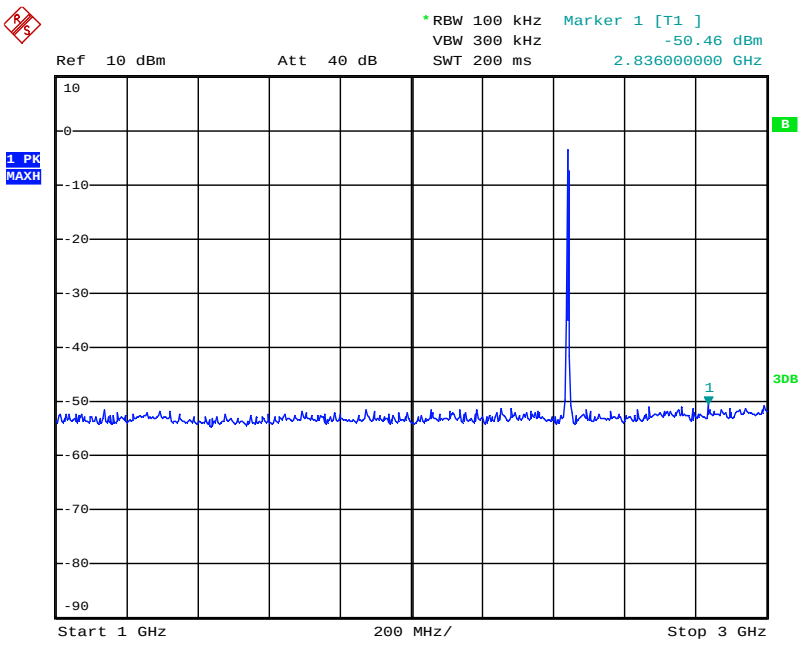

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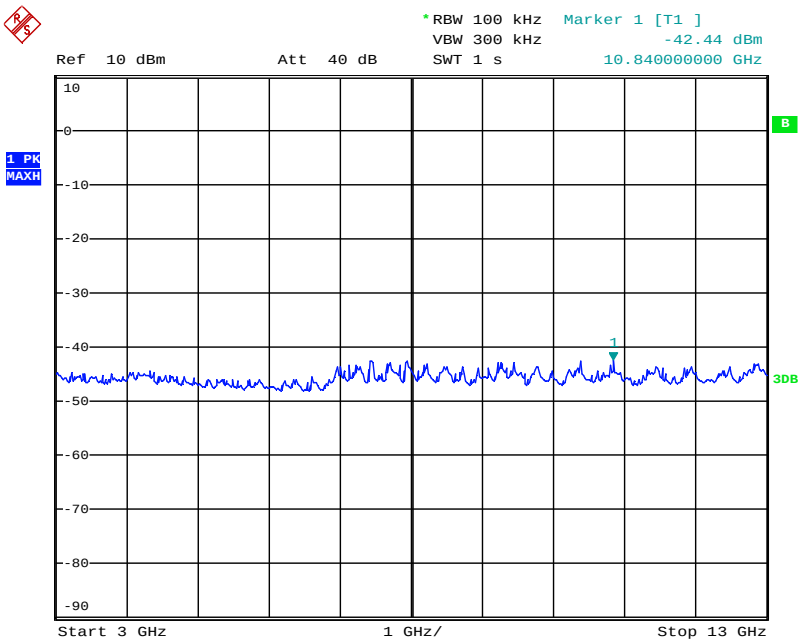

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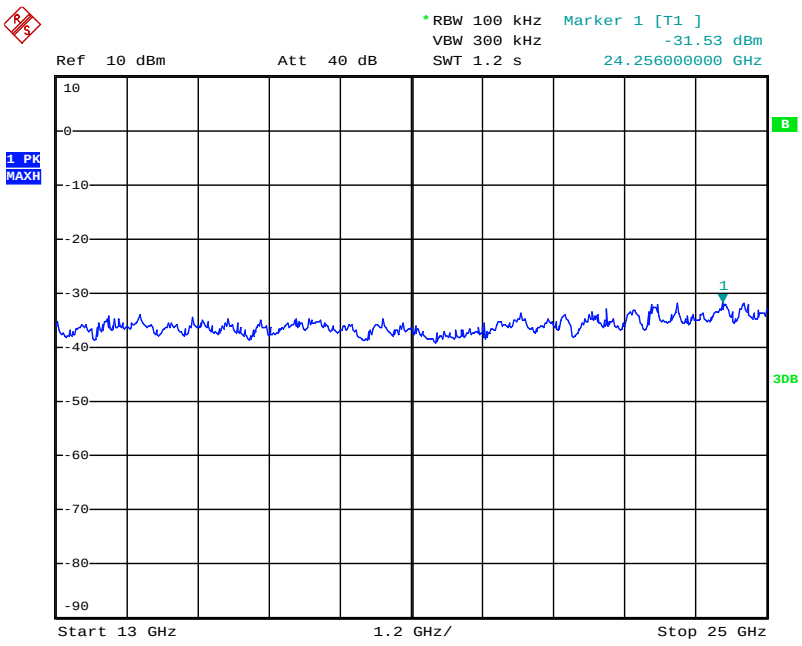

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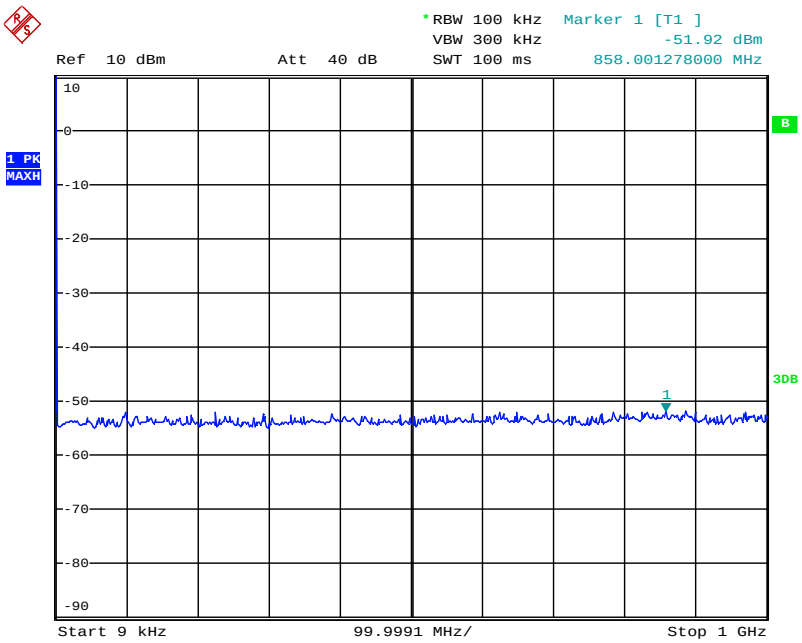
TX frequency: 2480MHz (ANT1)



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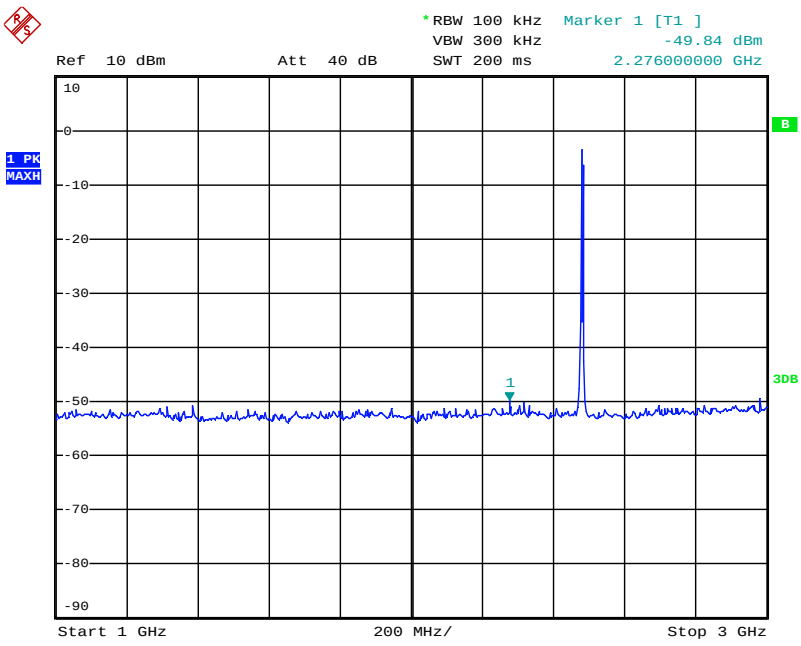

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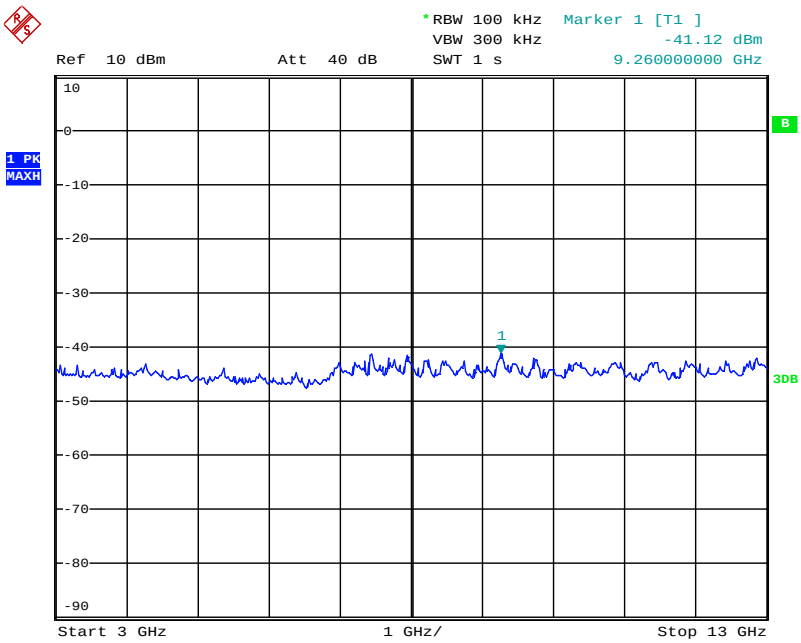

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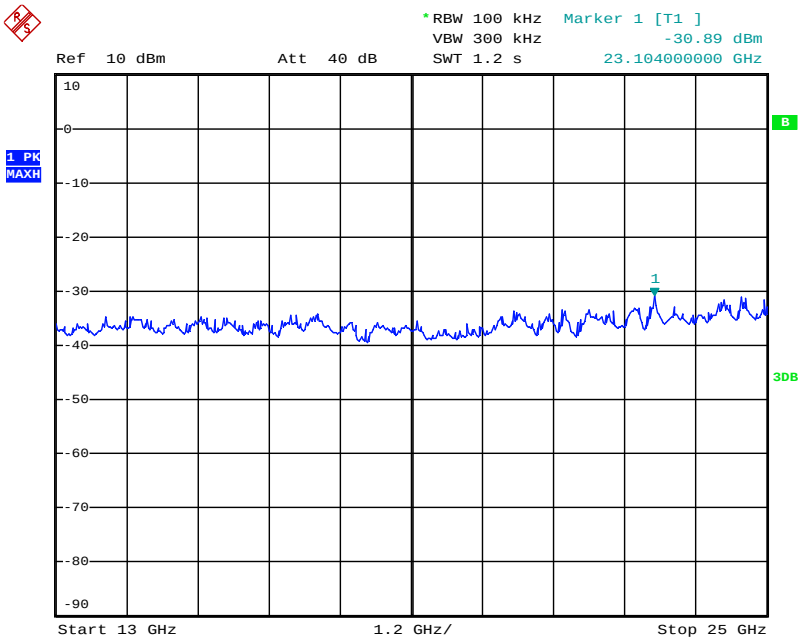

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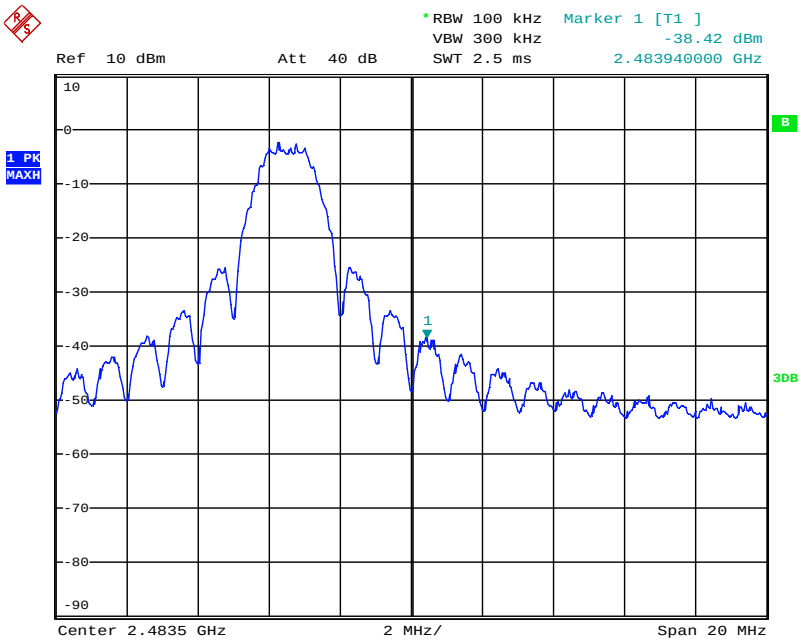
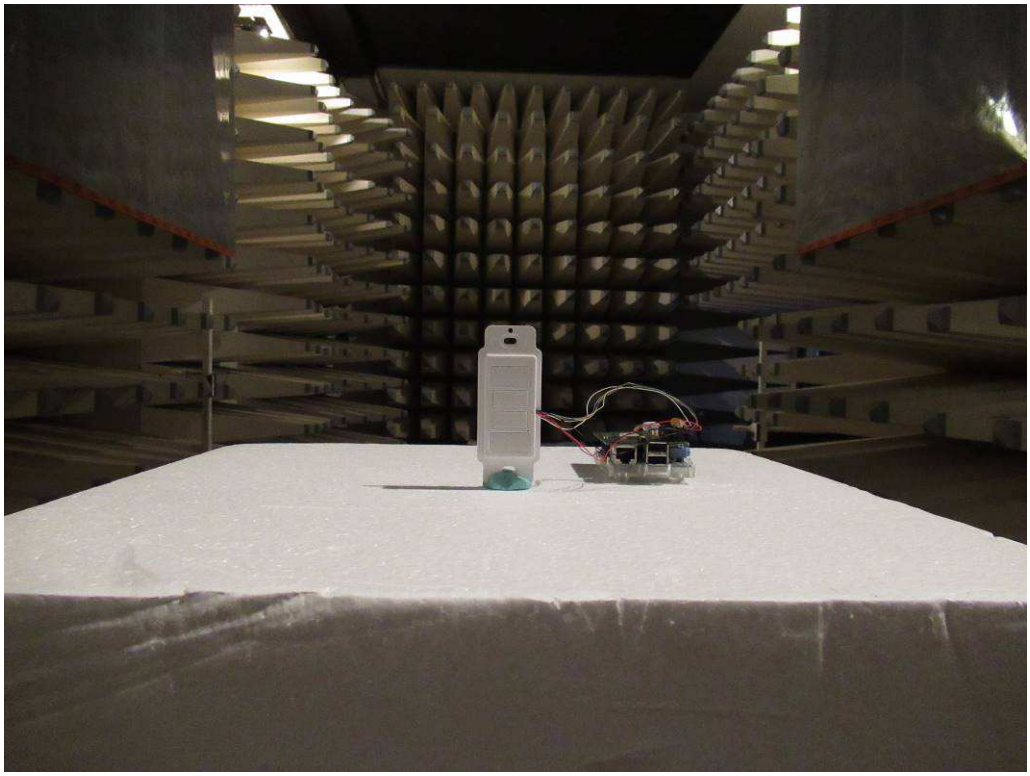


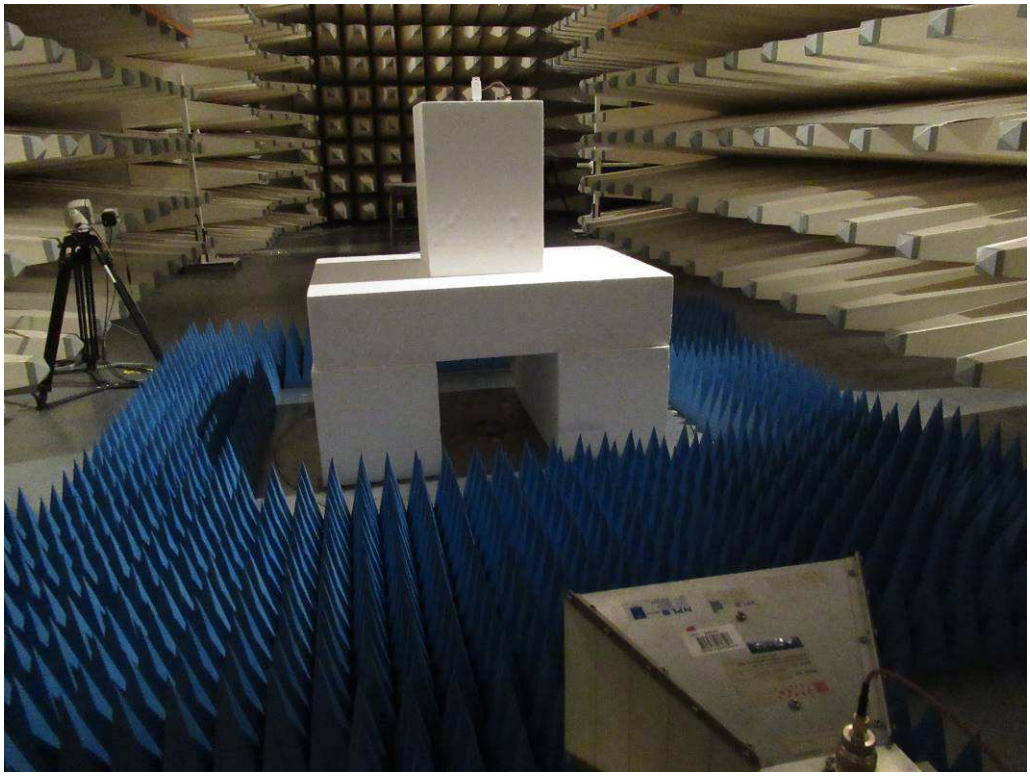
Date: 15.MAY.2018 14:59:37

Appendix 2

Test Setup Photos



Set-up for Radiated Emission



Set-up for Radiated Emission

Appendix 3

EUT External Photos

External View

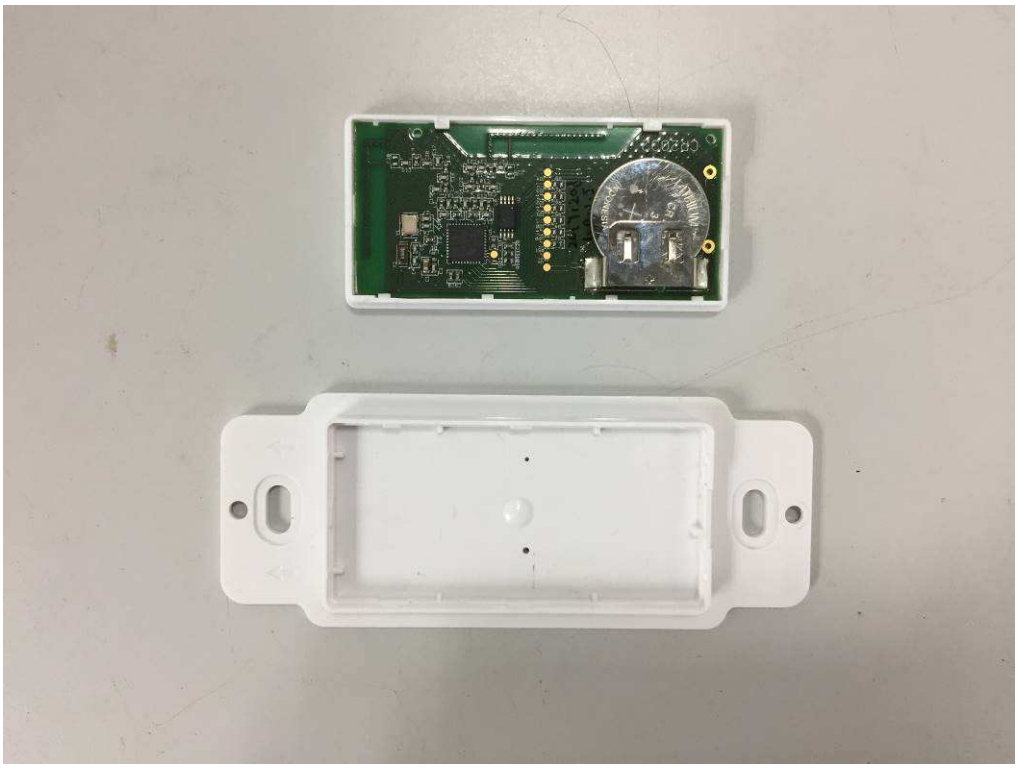
External View

External View

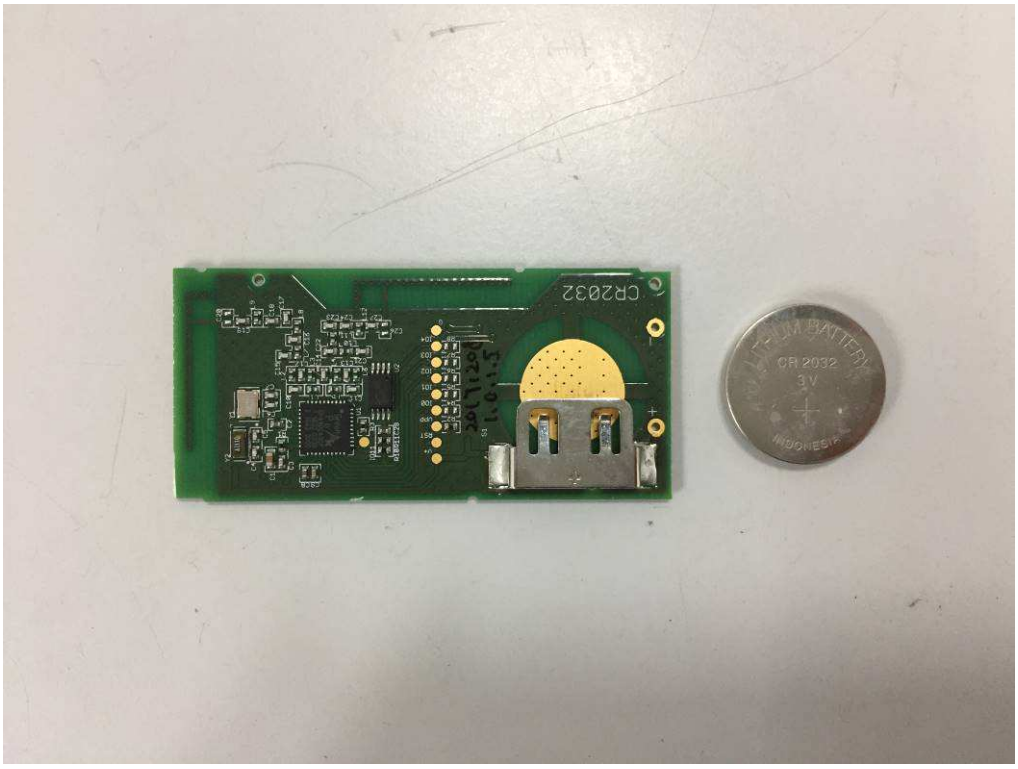
External View

Appendix 4

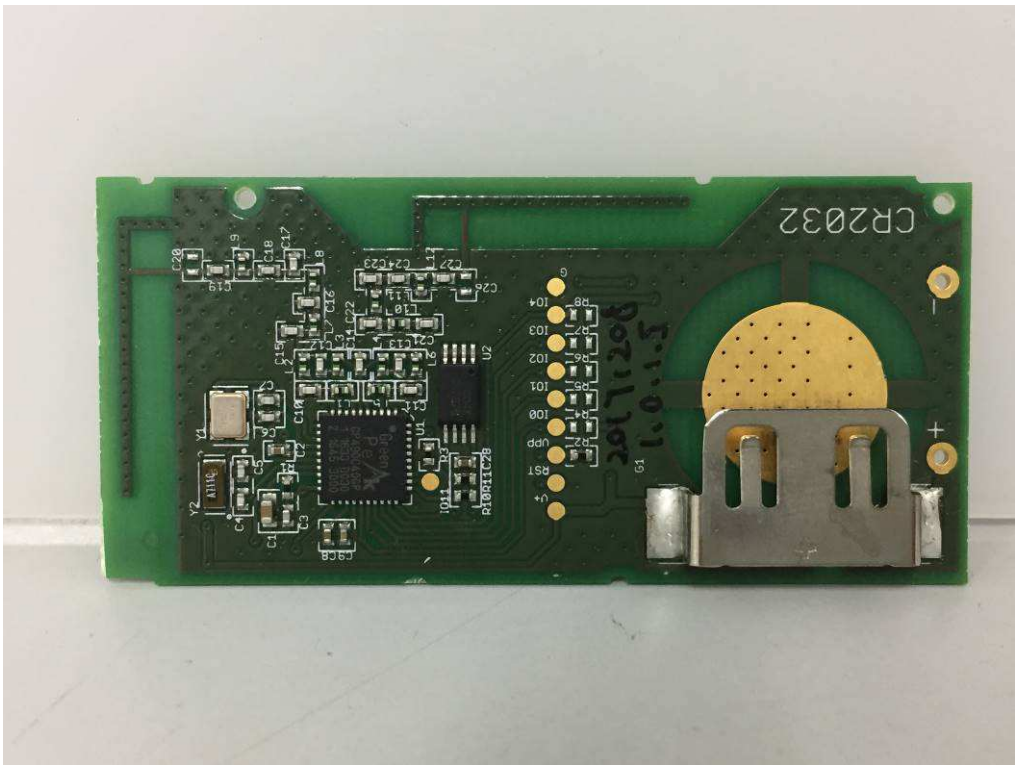
EUT Internal Photos



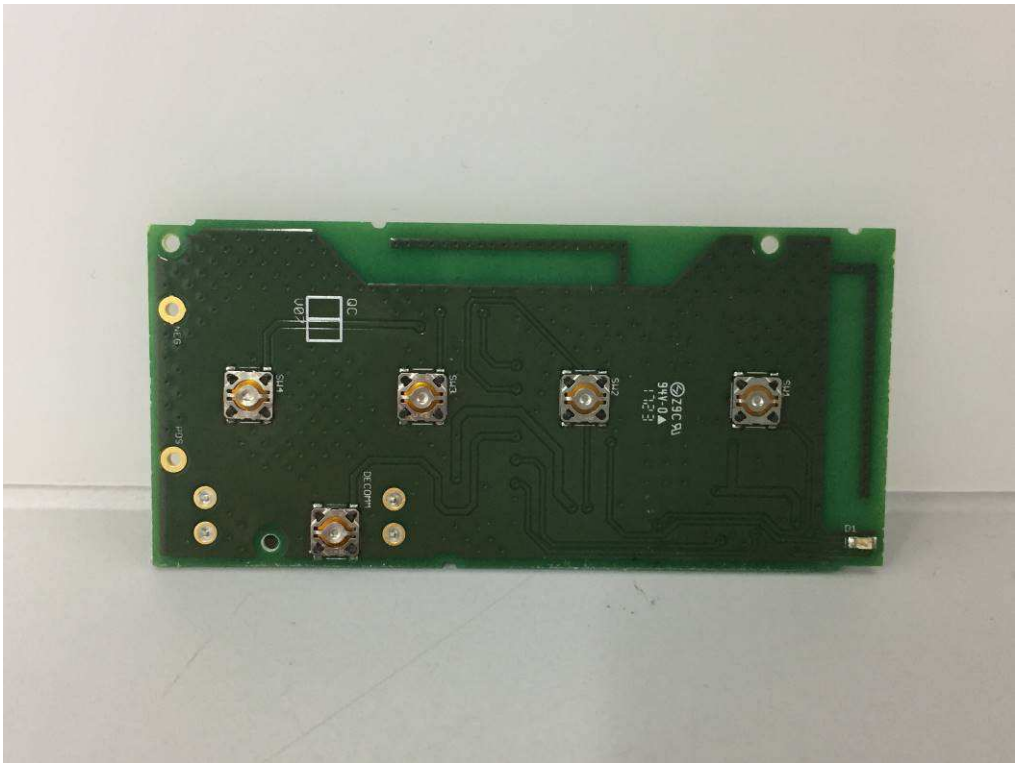
Internal View



Internal View



Internal View



Internal View

Appendix 5

RF Exposure Information

Maximum transmitter power:

Frequency (MHz)	Maximum peak output power (dBm)	Output power(mW)
2405	3.04	2.01
2440	2.82	1.91
2480	2.49	1.77

According to KDB 447498 D01:
The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at *test separation distances* ≤50 mm are determined by:
[(*max. power of channel, including tune-up tolerance, mW*)/(*min. test separation distance, mm*)] · [$\sqrt{f_{(GHz)}}$] ≤3.0 for 1-g SAR and ≤7.5 for 10-g extremity SAR,[24] where
• $f_{(GHz)}$ is the RF channel transmit frequency in GHz
• Power and distance are rounded to the nearest mW and mm before calculation[25]
• The result is rounded to one decimal place for comparison
• 3.0 and 7.5 are referred to as the numeric thresholds in the step 2 below

Result:

(2.01/5)*$\sqrt{}$2.405 = 0.62 <3.0

(1.91/5)*$\sqrt{}$2.440 = 0.59 <3.0

(1.77/5)*$\sqrt{}$2.480 = 0.55 <3.0

Conclusion:
No SAR is required.